TURCK

Industrial
Automation

USER MANUAL

IO-LINK MASTER FOR BL20 AND BL67

Sense it! Connect it! Bus it! Solve it!

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1.1 Documentation concept

This manual contains all information concerning the TURCK IO-Link master module for the product series BL20 and BL67 (BL20-E-4IOL or respectively BL67-4IOL).

The following chapters contain:

- A short description of the communication interface IO-Link,
- The general technical data and module properties,
- A description of the IO-Link master functionality,
- A general description of the function block (FB) IOL_Call and its in- and output variables,
- A description of the usage the IOL_CALL in PROFIBUS/PROFINET,
- A description of the usage the IOL_CALL in CODESYS 2.3,
- helpful information for the operation of IO-Link devices and a list of possible failure causes

1.2 Explanation of symbols used

1.2.1 Warnings

Action-related warnings are placed next to potentially dangerous work steps and are marked by graphic symbols. Each warning is initiated by a warning sign and a signal word that expresses the gravity of the danger. The warnings have absolutely to be observed:

DANGER!

DANGER indicates an immediately dangerous situation, with high risk, the death or severe injury, if not avoided.

WARNING!

WARNING indicates a potentially dangerous situation with medium risk, the death or severe injury, if not avoided.

o

CAUTION!

WARNING indicates a potentially dangerous situation with medium risk, the death or severe injury, if not avoided.

ATTENTION!

CAUTION indicates a potentially dangerous situation with low risk, middle or low injury, if not avoided.

1.2.2 Further notes

NOTE

In NOTES you find tips, recommendations and important information. The notes facilitate work, provide more information on specific actions and help to avoid overtime by not following the correct procedure.

TECHNICAL BASICS

The technical basics offer technical information, the basics and background information. This information lead to a better understanding of the device functions for example. The experienced user can skip this information.

➤ CALL TO ACTION

This symbol identifies steps that the user has to perform.

➥ RESULTS OF ACTION

This symbol identifies relevant results of steps

1.3 General notes

Please read this section carefully. Safety aspects cannot be left to chance when dealing with electrical equipment.

This manual includes all information necessary for the prescribed use of the modules BL20-E-4IOL and BL67-4IOL. It has been specially conceived for personnel with the necessary qualifications.

1.3.1 Prescribed use

The devices described in this manual must be used only in applications prescribed in this manual or in the respective technical descriptions, and only with certified components and devices from third party manufacturers.

Appropriate transport, storage, deployment and mounting as well as careful operating and thorough maintenance guarantee the trouble-free and safe operation of these devices.

1.3.2 Notes concerning planning/installation of this product

All respective safety measures and accident protection guidelines must be considered carefully and without exception.

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2.1 IO-Link - the fieldbus independent communication interface

TECHNICAL BASICS

IO-Link is a fieldbus-independent communication interface for sensors and actuators.
It is based on the IO-Link specification "IO-Link Interface and System Specification" version 1.1.2, November 2012, and on the IEC 61131-9 (2013-09), ed. 1.0, "Programmable controllers - part 9: Single-drop digital communication interface for small sensors and actuators (SDCI)".
IO-Link is a point-to-point connection between an IO-Link device (e.g. sensor, I/O hub, valve terminal) and the IO-Link master. Up to now, the binary connection was only designed for transferring
switching information, but IO-Link now allows 2 bytes to be transferred normally in a 2.3 ms cycle via a combined switching status and data channel.
Other information can be exchanged in addition to the process values, such as parameters or diagnostic messages.
This enables communication with sensors and actuators down to the "last meter" to be established for universal communication.

2.1.1 General technical information

TECHNICAL BASICS

- Standard I/O-connection technologies in point-to-point connection, unshielded, 20 m wire length
- Cyclic process data transfer in typ. 2.3 ms
- Parallel service data exchange without any impact on the process data
- Communication via 24 V-pulse modulation, standard UART protocol
- Communication between master and device in 3 different transmission speeds
  - 4.800 Baud (COM 1)
  - 38.400 Baud (COM 2)
  - 230.400 Baud (COM 3)

2.1.2 Data transmission

TECHNICAL BASICS

Basically 4 different types of data exist, which are transmitted either cyclically or acyclically.

– Process data → cyclic data exchange
– Value status → cyclic data exchange
– Device data → acyclic data exchange
– Events → acyclic data exchange

Process data:
The devices' process data are transmitted cyclically, whereas the process data size is defined through the device. The device process data can contain from 0 to 32 Byte (for both in- and output).

Value status:
The value status displays if process data are valid or not. It is transmitted cyclically with the process data.

Device data:
Device data are parameters, identification data and diagnostic information. The transmission is done acyclically and only on demand of the IO-Link master.

Events:
Events are error messages or warnings/maintenance data. Error messages are transmitted from the device to the PLC or similar via the IO-Link master. The IO-Link master itself can also transmit events and status information. Those events can be for example an open circuit, communication loss or an overload.

2.1.3 Transmission media

TECHNICAL BASICS

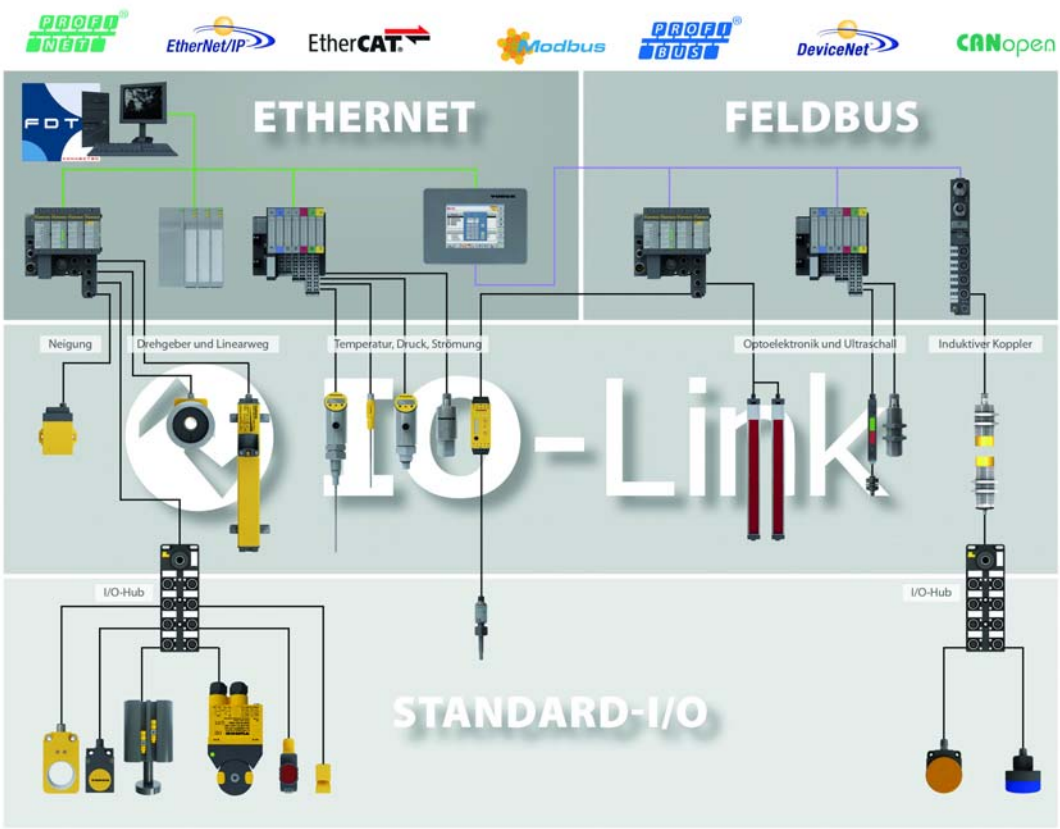
IO-Link does not require any special wiring. The sensors and actuators can continue to be connected using the proven, attractively priced and unshielded industrial cables.
The operating modes available for selection are the standard switch mode and the communication mode.

2.1.4 Fieldbus/Ethernet integration

TECHNICAL BASICS

– Usage of the standard-transport mechanisms of established fieldbusses/sensor/actuator buses
– (DPV0, DPV1, Ethernet …)
– simple integration in engineering systems by means of configuration files (GSD, GSDML, …)
– comfortable usage of even complex product features by means of tool based engineering (FDT/DTM, …)

Figure 2-1: IO-Link overview



2.1.5 IO-Link and FDT/DTM

TECHNICAL BASICS

FDT enables a fieldbus and system independent engineering environment to be set up. Generic DTMs allow any type of sensor and actuator to be integrated easily in the system.

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3.1 General

The TURCK IO-Link master modules BL20-E-4IOL or respectively BL67-4IOL are technology modules of the modular I/O-systems BL20 and BL67. They can be connected to several fieldbus systems and Ethernet protocols via the respective gateways.

The IO-Link module provides 4 IO-Link master channels and 4 universal digital channels (PNP).

The four IO-Link channels can be parameterized independently and can optionally be operated in IO-Link mode (IOL) or in standard I/O mode (DI mode).

The four universal digital channels are designed as XSG-channels and can therefore be parameterized as in- or output.

Properties:

- 4-channel IO-Link master according to IO-Link specification V1.1
- 4 universal digital channels, PNP, channel diagnostics, 0,5 A

3.1.1 Module overview

- BL67-4IOL

Figure 3-1: BL67-4IOL

- BL20-E-4IOL

Figure 3-2: BL20-E-4IOL

3.1.2 Compatible gateways

BL20 gateways

Table 3-1: Compatible BL20 gateways

Fieldbus	Product	Ident no.	from FW version
– PLC systems with PROFIBUS-DP master.			
PROFIBUS-DP	BL20-GW-DPV1	6827234	V1.27
	BL20-E-GW-DP	6827250	V1.27
– Multiprotocol Ethernet gateway for PROFINET, EtherNet/IP™ or Modbus TCP			
Ethernet – PROFINET – EtherNet/IP™ – Modbus TCP	BL20-E-GW-EN	6827239	V3.2.9.0

BL20 - CODESYS programmable gateways

NOTE

For the programmable gateways, the version of the Target Support Package always has to be observed in addition to the firmware version.

Table 3-2: Compatible programmable BL20 gateways

Fieldbus	Product	Ident no.	from FW version	from Target Support Package
– PLC systems with Modbus TCP master or PC based solutions using a Modbus driver software.				
Modbus TCP	BL20-PG-EN	6827249	V2.1.1.1	V2.1.3.0
– PLC systems with EtherNet/IP™ Scanner (master).				
EtherNet/IP™	BL20-PG-EN-IP	6827248	V2.10.0.3	V2.1.3.0

BL67 gateways

Table 3-3: Compatible BL67 gateways

Fieldbus	Product	Ident no.	from FW version
– PLC systems with PROFIBUS-DP master.			
PROFIBUS-DP	BL67-GW-DPV1	6827232	V1.27
– Multiprotocol Ethernet gateway for PROFINET, EtherNet/IP™ or Modbus TCP			
Ethernet – PROFINET – EtherNet/IP™ – Modbus TCP	BL67-GW-EN	6827214	≥ V3.1.0.0

BL67 - CODESYS programmable gateways

NOTE

For the programmable gateways, the version of the Target Support Package always has to be observed in addition to the firmware version.

Table 3-4: Compatible programmable BL67 gateways

Fieldbus	Product	Ident no.	from FW version	from Target Support Package
– PLC systems with PROFIBUS-DP master.				
PROFIBUS-DP	BL67-PG-DP	6827240	V2.0.5.0	V2.1.3.0
– PLC systems with Modbus TCP master or PC based solutions using a Modbus driver software.				
Modbus TCP	BL67-PG-EN	6827241	V2.1.1.0	V2.1.3.0
– PLC systems with EtherNet/IP™ Scanner (master).				
EtherNet/IP™	BL67-PG-EN-IP	6827246	V2.10.0.3	V2.1.3.0

3.2 Technical data

NOTE

For all technical data that are specific for the product lines, please read the I/O-manuals of the respective product family (BL20: D300717 and BL67: D300529).

Table 3-5: Technical data

	BL20-E-4IOL	BL67-4IOL
Module bus current I_{MB}	max. < 40 mA	
Nominal current from field supply	< 50 mA	
Inverse-polarity protection	yes	
Power loss	< 2.6 W	
Galvanic isolation		
U_{sys}/U_L/FE	500 V DC	
Bridging power failure		
Time	10 ms	
Repeat rate	1/s	
Sensor supply	from U_L: 24 V DC (20.4 VDC to 30 VDC)	from V_{sens}: 24 V DC (20.4 VDC to 30 VDC)
Short-circuit protection	-	yes, 4 A via the gateway
Output current I_A	0.5 A	
I_{AMAX}	0,6 A, according to IEC 6 11 31-2	
Operating temperature	0 to +55 °C	-40 to +70 °C **Restriction:** Usage of the IO-Link port as digital input: -40 to +55 °C
Connection technology	Push-in tension clamp terminals	M12
Inputs	4	
Input type	digital pnp inputs, type 1 according to EN 61 131-2:2007	
Signal voltage, low level	< 5 V	
High-level signal voltage	> 11 V	
Low-level signal current	< 1,5 mA XSG/ < 5 mA (IO-Link port as DI)	
High-level signal current	2,1 to 3,7 mA XSG/ 6 to 12 mA (IO-Link port as DI)	
Electrical isolation	electronic to field	

Outputs	4
Output type	pnp
Output current per channel	0.5 A
Output delay	1 ms
Load type	ohmic, inductive, lamp load
Resistive load	> 48 Ω
Load impedance, inductive	< 1,2 H
Lamp load	< 3 W
Switching frequency, resistive	< 200 Hz
Switching frequency, inductive	< 2 Hz
Switching frequency, lamp load	< 20 Hz
Electrical isolation	electronic to field
IO-Link	
Number of ports	4
IO-Link specification	V1.0, V1.1 according to IEC 61 131-9
IO-Link port type	Class A
Frame type	Supports all specified frame types
Supported devices	Maximum 14 byte input/14 byte output
Transmission rate	4,8 kbps (COM 1) 38,4 kbps (COM 2) 230,4 kbps (COM 3)
Transmission cable	Length: max. 20 m standard cables, 3- or 4-wire (depending on the application), unshielded

3.3 Base modules/wiring diagrams

3.3.1 General

ATTENTION!

Wrong supply of IO-Link devices

Damage to the electronics

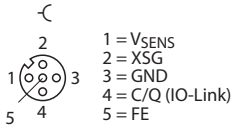
➤ The IO-Link devices must only be supplied with the voltage provided at the supply terminals

BL67: V_{sens} (pin 1 and 3)

BL20: U_L(terminal 9 and 10)

3.3.2 BL67

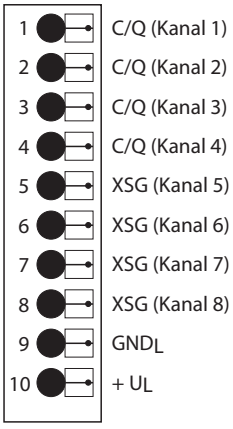
Table 3-6: Wiring diagram BL67

Base module	Wiring diagram
BL67-B-4M12	
The connection of the, at maximum, 4 IO-Link devices is done via pin 4 of the 4 M12-connectors. The universal XSG-channel (in-or output) is provided at pin 2.	

3.3.3 BL20

Figure 3-3: Wiring diagram BL20

Wiring diagram



The connection of the, at maximum, 4 IO-Link devices is done via terminals 1 to 4.
The universal XSG-channel (in-or output) is provided at terminals 5 to 8.

Special notes for supplying the IO-Link devices for BL20

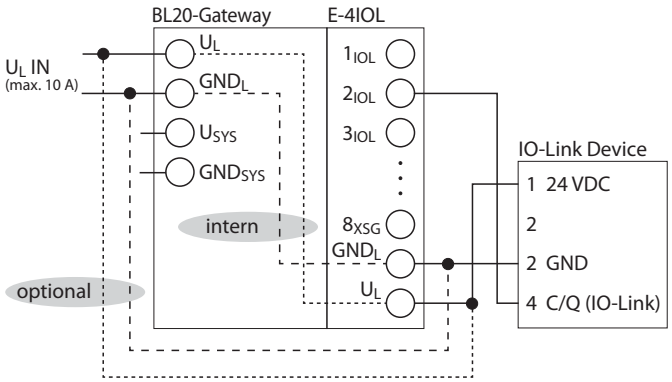


Figure 3-4: Power supply of the IO-Link devices when using BL20-E-4IOL

ATTENTION!

Insufficient fuse protection of U_L

Damage to the electronics

➤ U_L has to be protected by a fuse with max. 8 A/10 A (depending on type of gateway). More information can be found in the respective gateway manuals.

ATTENTION!

Wrong ground potential

Damage to the electronics

➤ The IO-Link devices must be supplied with the same potential as U_L of the gateway or the BR/PF module (if used).

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4.1 Process image

The 4IOL-module provides a maximum of 16 byte of process input data and a maximum of 16 byte of process output data.

The process image can be adapted application-specifically via the module's parameterization, see Process data mapping (page 4-4).

4.1.1 Process input data

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	XSG8	XSG7	XSG6	XSG5	DI4	DI3	DI2	DI1
	1	OC8	OC7	OC6	OC5	DVS4	DVS3	DVS2	DVS1
Process input data mapping	2 to 15	Mapped process input data							

Table 4-1: Process input data mapping

Name	Value	Meaning
DIx	Digital input	
	0	No signal at DI
	1	Input signal at DI
XSGx	XSG input	
	0	No signal at XSG
	1	Input signal at XSG
DVSx	Input value valid (Data Valid Signal)	
	0	The IO-Link data are not valid. Possible causes: – Sensor supply is below the admissible range, – IO-Link port is parameterized as simple digital input, – No device connected to the masters, – No input data received from the connected device (only valid for devices with an input data length > 0), – No reaction from the connected device to the sending of output data (only valid for devices with an output data length > 0), – The connected device sends an error "process input data invalid.
	1	The IO-Link data are valid.
OCx	Overcurrent XSG channel	
	0	No overcurrent
	1	Overcurrent at the output (if the XSG channel is used as output)
Mapped process input data		
Process input data of the connected device It depends on the parameterization of the channel which data are shown in which order (see parameter "process input data length" and "process input data mapping").		

4.1.2 Process output data

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Control	0	XSG8	XSG7	XSG6	XSG5	reserved			
	1	reserved							
Process output data mapping	2 to 15	Mapped process output data							

Table 4-2: Process output data

Name	Value	Meaning
XSGx	XSG output	
	0	Output not active
	1	Output active, max. output current 0.6 A
Process output data		
Mapped process output data of the connected device. It depends on the parameterization of the channel which data are shown in which order (see parameter "process output data length" and "process output data mapping").		

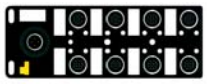
4.1.3 Process data mapping

The mapping of process data can be adapted application-specifically via the master's parameterization.

Depending on the used fieldbus, it can be necessary to swap process data word-wise, double word-wise or completely in order to align them to the data structure in the PLC.

The process data mapping is determined channel by channel through the parameters "process input data mapping" "process output data mapping", "process input data length" and "process output data length" (see section „Parameters“).

Example mapping for field buses with Little Endian-format:

Mapping by master → fieldbus → PLC			**Mapping IO-Link device**		**Devices at channel 1... 4**	**Channel parameterization** (see page 4-8)
		Byte A		**Byte A**		
Byte 0	Status					
Byte 1	Control					
Byte 2	Distance	Low byte	Distance	High byte		2 byte process data (swap 16 bit)
Byte 3		High byte		Low byte		
Byte 4	Digital signal	1... 8	Digital signal	1 ... 8		2 byte process data (direct)
Byte 5	Digital signal	9 ...15	Digital signal	9 ...15		
Byte 6	Angle x-axis	Low byte	Angle x-axis	High byte		4 byte process data (swap 16 bit)
Byte 7		High byte		Low byte		
Byte 8	Angle y-axis	Low byte	Angle y-axis	High byte		
Byte 9		High byte		Low byte		
Byte 10	Diagnostics		Counter/ position value	MSByte		4 byte process data (swap all)
Byte 11	Counter/ position value	Low byte		High byte		
Byte 12		High byte		Low byte		
Byte 13		MSByte	Diagnostics			
Byte 14	reserved					
Byte 15	reserved					

A

MSByte: Most Significant Byte

4.2 Parameters

The module provides 16 byte parameter data, 4 byte per port:

channel	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Channel 1	0	Activate output	Quick Start-Up	Data storage mode		Mode			
	1	Cycle time							
	2	Mapping Process output data		Mapping Process input data mapping		Deactivate diagnostics deactivate web server		Process input data invalid	Revision
	3	Process output data length				Process input data length			
Channel 2	4 - 7	Assignment similar to channel 1							
Channel 3	8 - 11	Assignment similar to channel 1							
Channel 4	12 - 15	Assignment similar to channel 1							

Table 4-3: Parameters

Name	**Meaning**	
Value		
Mode		
0000	IO-Link without validation **A**	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) is operated in IO-Link mode. The master does not check if the connected device matches the configured one
0001	IO-Link with compatible device	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) is operated in IO-Link mode. The master checks if the device type (vendor-ID and device-ID) of the connected device matches the device type of the configured one. If the master detects a mismatch, the IO-Link communication is established, but there is no process data exchange. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.
0010	IO-Link with identical device	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) is operated in IO-Link mode. The master checks if the device type (vendor-ID **and** device-ID) and the serial number of the connected device match the data of the configured one. If the master detects a mismatch, the IO-Link communication is established, but there is no process data exchange. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.

A *default setting*

Table 4-3: Parameters

A *default setting*
v

Name	**Meaning**	
Value		
Mode		
0011	DI (with parameter access)	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) is generally operated as simple digital input. However, an acyclic parameter access from the PLC or the DTM is possible. The IO-Link master starts the port in IO-link mode, parameterizes the device and sets the port back into DI-mode. The port remains in DI mode until a new IO-Link request is sent from the higher-level control. Data storage is **not** supported! Connected devices have to support the SIO-mode (DI-mode).
0100	DI	Pin 4 (BL67) of the respective connector or the respective terminal 1/2/3 or 4 (BL20) is operated as simple digital input. Data storage is **not** supported!

NOTE

Parameter Mode", "DI (with parameter access)":
In case of a parameter access, the IO-Link communication at the port is started.
Switching signals are interrupted!

Data storage mode		
Synchronization of parameter data of IO-Link devices (storing the parameter of the connected device in the master). If the synchronization is not possible, a diagnostic message is displayed (DS_{ERR}, see section „Diagnostic data“). In this case select option "11 = deactivated, clear" in order to clear the data buffer of the device.		
00	activated	Synchronization of parameter data activated. The most actual data (master or device) serve as the reference data.
01	overwrite	Synchronization of parameter data activated, the data in the master serve as reference data.
10	read in	Synchronization of parameter data activated. The data in the connected IO-Link device serve as reference data.
11	deactivated, clear **A**	Synchronization of parameter data deactivated. The data set in the master is deleted.

NOTE

IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage. In this case the data storage has to be deactivated (data storage mode: 11 = deactivated, clear).

Table 4-3: Parameters

A *default setting*

Name	Meaning	
Value		
Quick Start-Up		
For fast applications (e.g. tool changing applications) the start-up time of IO-Link devices can be shortened. The start-up time defined in the IO-Link specification (TSD = Device Detection Time) is reduced.		
00	no **A**	The start-up time is within the specified range (0.5 s). All IO-Link devices in accordance with the specification can be operated.
01	yes	The start-up time is reduced to approx. 100 ms. It is not supported by every IO-Link device. It can thus be necessary to check if the used IO-Link device starts in this mode.
Activate output		
00	no **A**	BL67: The output at pin 2 of the respective connector/port is deactivated. BL20: The output at the respective terminal (5 to 8) is deactivated.
01	yes	BL67: The output at pin 2 of the respective connector/port is activated. BL20: The output at the respective terminal (5 to 8) is activated.
Cycle time		
00	automatic **A**	The Master reads the minimum cycle time from the connected device.
00000001 - 11001111 (0×01 - 0×BF)	0.8 to 132.8 ms	Settable in steps of 0.8 or 1.6 ms. (see Table 4-4: Parameter values "cycle time" [ms] (page 4-9))
Revision		
00	automatic **A**	The Master defines the IO-Link-revision automatically.
01	V1.0	IO-Link-Revision V 1.0 is used.
Process input data invalid		
00	diagnostics generated **A**	If the process data are invalid, a respective diagnostic message is generated.
01	no diagnostics generated	Invalid process data do not cause a diagnostic message.

Table 4-3: Parameters

A *default setting*

Name	Meaning	
Value		
Deactivate diagnostics		
Influences the sending of IO-Link-Events from the master to the fieldbus. Depending on the parameterization, the master transmits Events based on their priority to the fieldbus or not.		
00	no	The master transmits all IO-Link Events to the fieldbus.
01	notifications	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications.
10	notifications and warnings **A**	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications and warnings.
11	yes	The master doesn't transmit any IO-Link Event to the fieldbus.
Process input data mapping		
Optimization of the process data mapping for the used fieldbus: The I/O-Link-data can be swapped depending on the used fieldbus in order to achieve an optimized data mapping on the fieldbus side.		
00	direct	The process data are not swapped.
01	swap 16 bit **A**	The process data are swapped word-wise.
10	swap 32 bit	The process data are swapped double word-wise.
11	swap all	All bytes are swapped.
Process output data mapping		
see above "Process input data mapping"		
Process input data length		
Defines the length of the process input data which are mapped to the fieldbus for this port.		
0000	0 byte	
0001	1 byte	
0010	2 byte **A**	
0011	4 byte	
0100	6 byte	
0101	8 byte	
0110	10 byte	
0111	12 byte	
1000 - 1110	reserved	
1111	14 byte	

Table 4-3: Parameters

Name	Meaning
Value	
A *default setting*	**Process output data length**
	Defines the length of the process output data which are mapped to the fieldbus for this port.
0000	0 byte
0001	1 byte
0010	2 byte **A**
0011	4 byte
0100	6 byte
0101	8 byte
0110	10 byte
0111	12 byte
1000 - 1110	reserved
1111	14 byte

Values for the parameter "cycle time" [ms]:

Table 4-4: Parameter values "cycle time" [ms]

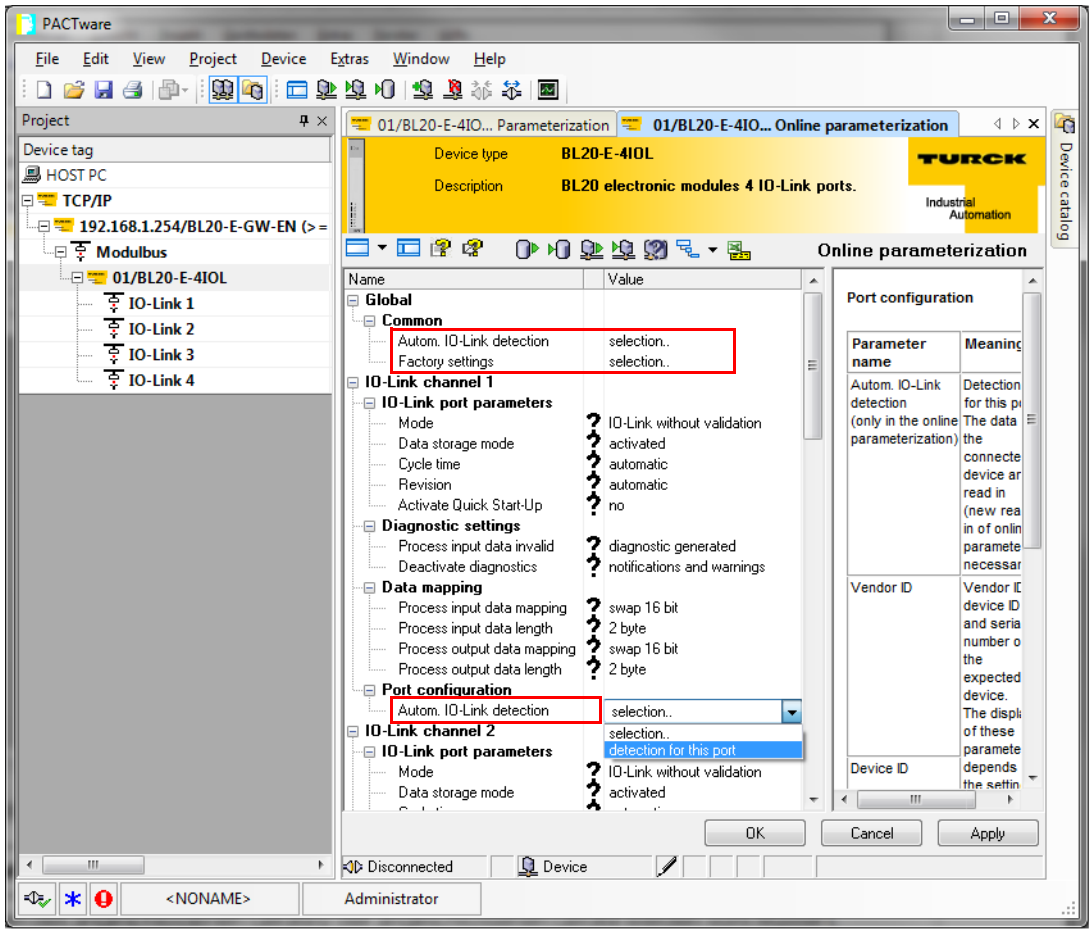
Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value
0.0	auto **A**	15.2	0×56	30.4	0×7C	59.2	0×91	89.6	0×A4	120	0×B7
0.8	0×08	16	0×58	31.2	0×7E	60.8	0×92	91.2	0×A5	121.6	0×B8
1.6	0×10	16.8	0×5A	32	0×80	62.4	0×93	92.8	0×A6	132.2	0×B9
2.4	0×18	17.6	0×5C	33.6	0×81	64	0×94	94.4	0×A7	124.8	0×BA
3.2	0×20	18.4	0×5E	35.2	0×82	65.6	0×95	96	0×A8	126.4	0×BB
4	0×28	19.2	0×60	36.8	0×83	67.2	0×96	97.6	0×A9	128	0×BC
4.8	0×30	20	0×62	38.4	0×84	68.8	0×97	99.2	0×AA	129.6	0×BD
5.6	0×38	20.8	0×64	40	0×85	70.4	0×98	100.8	0×AB	131.2	0×BE
6.4	0×40	21.6	0×66	41.6	0×86	72	0×99	102.4	0×AC	132.8	0×BF
7.2	0×42	22.4	0×68	43.2	0×87	73.6	0×9A	104	0×AD	-	-
8	0×44	23.2	0×6A	44.8	0×88	75.2	0×9B	105.6	0×AE	-	-
8.8	0×46	24.0	0×6C	46.4	0×89	76.8	0×9C	107.2	0×AF	-	-
9.6	0×48	24.8	0×6E	48	0×8A	78.4	0×9D	108.8	0×B0	-	-
10.4	0×4A	25.6	0×70	49.6	0×8B	80	0×9E	110.4	0×B1	-	-
11.2	0×4C	26.4	0×72	51.2	0×8C	81.6	0×9F	112	0×B2	-	-
12.0	0×4E	27.2	0×74	52.8	0×8D	83.2	0×A0	113.6	0×B3	-	-
12.8	0×50	28	0×76	54.4	0×8E	84.8	0×A1	115.2	0×B4	-	-
13.6	0×52	28.8	0×78	56	0×8F	86.4	0×A2	116.8	0×B5	-	-
14.4	0×54	29.6	0×7A	57.6	0×90	88	0×A3	118.4	0×B6	-	-

A *automatic: The lowest cycle time supported by the device is taken from the table.*

4.2.1 Special DTM functions

The TURCK DTMs offer, besides the normal parameters of the IO-Link master modules, special function for configuring the master module.

Figure 4-1: Special DTM functions



Automatic IO-Link detection

The data of the connected device/ the connected devices are read-in by the master.

This function affects, depending on the parameter group in which it is activated, all ports or only one special port. In the "Common"-group it is valid for the whole module, in the "Port configuration" group it is only valid for the respective port.

Factory settings

The master is set back to its factory settings.

4.3 Diagnostic and status messages

4.3.1 LED status displays

This module provides the following LEDs for status displays:

- DIA: Monitors the module status
- Channel LEDs
  - BL67:
    0 - 3: Status display for the IO-Link- or respectively DI-channels at Pin 4 of the M12 connectors
    4 - 7: Status display for the XSG-channels at Pin 2 of the M12 connectors
  - BL20:
    1 -4: Status display for the IO-Link- or respectively DI-channels at terminal 1 - 4.
    5 - 8: Status display for the XSG-channels at terminal 5 - 8.

Table 4-5: Meaning of the LEDs

LED	Color	Status	Meaning	Remedy
D/DIA	Red	on	Module bus communication disturbed or/and no field voltage connected.	– Check if more than two adjoining electronics modules have been pulled. This concerns modules located between this module and the gateway. – Check the field supply.
		flashing, 0.5 Hz	Module diagnostics pending	– see section „Diagnostic data“, page 4-13
0 - 3 (BL67) or resp. **1 - 4** (BL20)	**Channel in IO-Link mode**			
	Green	off	No IO-Link communication, diagnostics deactivated	– connect an IO-Link device – parameterize the channel as DI if necessary
		flashing	IO-Link communication active, valid process data	-
	Red	on	No IO-Link communication and/ or module error, invalid process data	Possible causes: – Sensor supply is below the admissible range, – IO-Link port is parameterized as simple digital input, – No device connected to the masters,

Table 4-5: Meaning of the LEDs

LED	Color	Status	Meaning	Remedy
0 - 3 (BL67) or resp. **1 - 4** (BL20)	Red	flashing	IO-Link communication active and module error, invalid process data	– No input data received from the connected device (only valid for devices with an input data length > 0), – No reaction from the connected device to the sending of output data (only valid for devices with an output data length > 0), – connected device sends an error: "process data invalid". see also: Start-up problems - frequent failure causes (page 8-4)
	Channel in DI-mode			–
	Green	off	Status of channel x = "0" (OFF)	
	Green	on	Status of channel x = "1" (ON)	–
4 - 7 (BL67) or resp. **5 - 8** (BL20)	Green	off	Status of channel x = "0" (OFF)	
	Green	on	Status of channel x = "1" (ON)	–
	Red	flashing, 0.5 Hz	Short circuit at output of the respective channel	

4.3.2 Diagnostic data

There are different types of diagnostic messages, master and device diagnostics.
The "$PD_{invalid}$" diagnostic (process data invalid) can be sent from both devices, IO-Link master or IO-Link device.

Master diagnostics

The master sends reports problems within the IO-Link communication.

Device diagnostics

The device diagnostics map the IO-Link Event codes (according to the IO-Link specification) sent from the IO-Link devices to the diagnostic telegram of the master.

Event codes can be read from the connected devices by using appropriate device tools (e.g. IODD-Interpreter).

Further information about the IO-Link Event codes and their meaning can be found in the IO-Link specification or in the documentation of the connected IO-Link devices.

Diagnostic telegram

channel	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		Device diagnostics				Master diagnostics			
Channel 1	0	EVT_{D1}	EVT_{D2}	$PD_{invalid}$	HW_{ERR}	DS_{ERR}	CFG_{ERR}	res.	OC
	1	Gen_{ERR}	OLD	OV	UV	OFLW	UFLW	OTemp	$Param_{ERR}$
Channel 2	2 + 3	Assignment similar to channel 1							
Channel 3	4 + 5	Assignment similar to channel 1							
Channel 4	6 + 7	Assignment similar to channel 1							

Table 4-6: Diagnostic data

Bit	Meaning	Remedy
Master diagnostics		
OC	overcurrent	
	Overcurrent at the XSG-channel if it is parameterized as output.	
CFG_{ERR}	Wrong or missing device	
	The connected device does not match the channel configuration or there is no device connected to the channel. This diagnostic message depends on the parameterization of the channel (see parameters, page 4-5).	Change the parameterization of the IO-Link port at the master. Correct the vendor-ID, device-ID, etc. The parameterization can be done by teaching the master via IOL_CALL using the port function Subindex 67: Teach Mode or via a manual port parameterization.

Table 4-6: Diagnostic data

Bit	Meaning	Remedy
DS_{ERR}	Data storage error	
	Possible causes:	
	– Data storage mismatch	IO-Link device in accordance with IO-Link V1.0 connected. Deactivate the data storage. To do so, set parameter "Data storage mode" to "deactivated, clear", see page 4-6.
		The data storage buffer contains data of another device. Clear the data storage buffer of the master. To do so, set the parameter "Data storage mode" to "deactivated, clear", see page 4-6, and re-activate the data storage if necessary.
	– Overflow of the data storage buffer	Clear the data storage buffer of the master. To do so, set the parameter "Data storage mode" to "deactivated, clear", see page 4-6, and re-activate the data storage if necessary.
	– Parameter access for data storage not possible	The connected device may be locked for parameter changes or for data storage. Check the status of the IO-Link index "Device Access Locks" (index 0×C) of the connected device and unlock the device.
Master/device diagnostics		
$PD_{invalid}$	Process input data invalid	
	The IO-Link master or the IO-Link device report invalid process input data.	The connected device is not in status "operate", which means, it is not ready for operation. Possible sources: The connected device does not match the configured one, additional diagnostic message Wrong or missing device.
		Certain IO-Link devices send a "process input data invalid"-diagnosis if the process value cannot be measured. Deactivate the sending of the "process input data invalid"-diagnosis for the respective port. To do so, change the parameter "Process input data invalid" to "no diagnostics generated", see page 4-7.
Device diagnostics		
For the exact specification of the device diagnostics, please read the device documentation of the device manufacturer.		

Table 4-6: Diagnostic data

Bit	Meaning	Remedy
HW Error	hardware failure	
	General hardware error or device malfunction.	
EVTD2	Out-of-Specification Events	
	An Out-of-Specification Event in accordance with the IO-Link specification occurred.	
EVTD1	Maintenance Events	
	A Maintenance Event in accordance with the IO-Link specification occurred, maintenance necessary.	
$Param_{ERR}$	Parameterization error	
	The connected device reports a parameterization error (loss of parameters, no parameter initialization, etc.).	
OTemp	Overtemperature	
	Temperature diagnostic message at the connected device.	
UFLW	Lower limit value underrun	
	The process value lies under the parameterized measurement range or the chosen measurement range has been chosen too high.	
OFLW	Upper limit value exceeded	
	The process value exceeds the parameterized measurement range or the chosen measurement range has been chosen too low.	
UV	Undervoltage	
	One of the voltages at the connected device is below the defined range.	
OV	Overvoltage	
	One of the voltages at the connected device is below the defined range.	
OLD	Overload	
	The connected device detected an overload.	
GenERR	Common error	
	The device sends an error (device status 4, in accordance with IO-Link specification), which is not clearly specified. Read out the device event codes in order to be able to specify the error more precisely.	

4.4 The principle of the data storage mechanism

4.4.1 General

Data storage enables a user to change an IO-Link device when maintenance is required without any configuration or parameterization.

The IO-Link master, as well as the IO-link device, store the device parameters. The data storage mechanism serves for synchronizing these different data storage buffers.

In case of a device change, the master writes the stored device parameters to the new device. The application can be re-started without any further intervention using a configuration tool or similar.

In the BIO-Link masters for BL20/BL67, the data storage mode can be set using the parameter "data storage mode" (see Parameters (page 4-5)).

Data storage mode

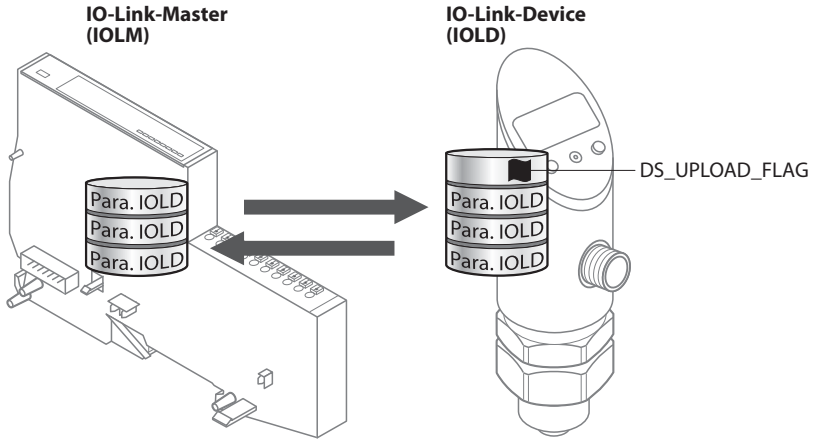
00 = activated (page 4-17)

01 = overwrite (see page 4-19)

10 = read in (see page 4-19)

11 = deactivated, clear (see page 4-19)

Figure 4-2: General principle of the data storage mechanism



Para. IOLD = parameter data of the IO-Link device

A change of parameters in the device is indicated by the status of the DS_UPLOAD_FLAG bit:

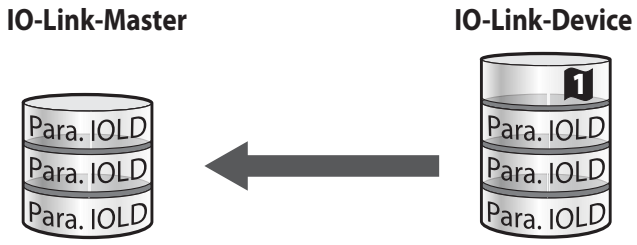
DS_UPLOAD_FLAG:
0 = no changes in the device's parameter set
1 = changes in the device's parameter set (e. g. via DTM, at the device, etc.)

4.4.2 Parameter "data storage mode" = activated

- The synchronization of the parameter sets is bidirectional.
- The most actual data set (master or device) is valid:
  This means:
  - The *data set in the device* is actual, if DS_UPLOAD_FLAG = 1
  - The *data set in the master* is actual, if DS_UPLOAD_FLAG = 0

Parameterizing a device in the installation:
A device, which is already used in the installation, is for example parameterized via a DTM.

DS_UPLOAD_FLAG = 1
→ changes in the device's parameter see

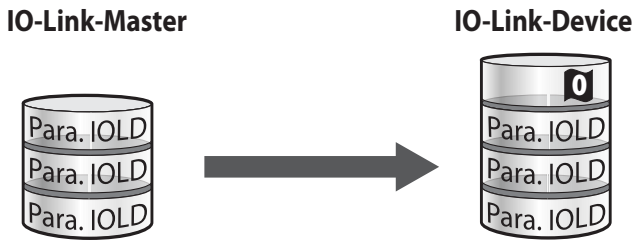


The IO-Link device is already connected to the master.

Para. IOLD = parameter data of the IO-Link device

Maintenance - exchange device in delivery status:
A defective device is replaced by a device in delivery status.

DS_UPLOAD_FLAG = 0
→ no changes in the device's parameter set

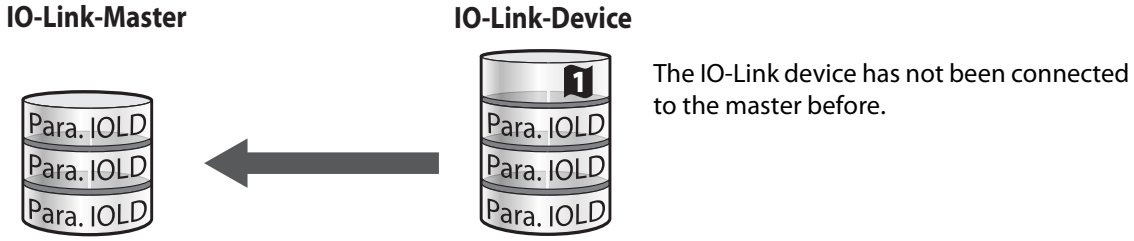


The IO-Link device has not been connected to the master before.

Para. IOLD = parameter data of the IO-Link device

Maintenance - exchange device with eventually modified parameter set:
A defective device is replaced by a device with a parameter set that was already changed before (for example via DTM).

DS_UPLOAD_FLAG = 1
→ changes in the device's parameter see



Para. IOLD = parameter data of the IO-Link device

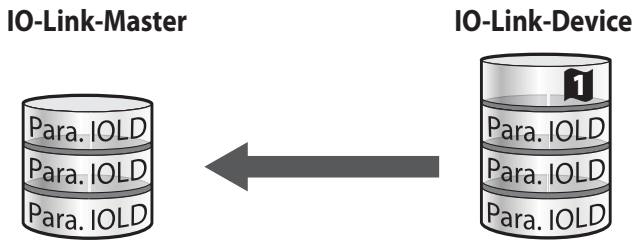
NOTE

If a device change is necessary when data storage is activated, the following has to be observed:
An IO-Link exchange device with unknown parameter data should be reset to factory defaults before connecting it to the master.
This prevents unknown device parameter settings to be downloaded to the master when establishing the connection.
TURCK IO-Link devices can be reset to factory settings via a system command using a generic IO-Link-DTM and the device-specific IODD.
For the reset of third party devices, please read the corresponding manufacturer documentation.

4.4.3 Parameter "data storage mode" = read in

- The data set in the device is **always** the reference data set.
- The synchronization of the parameter sets is unidirectional towards to the master.
- The status of the DS_UPLOAD_FLAG is ignored.

Figure 4-3: "Data storage mode" = read in

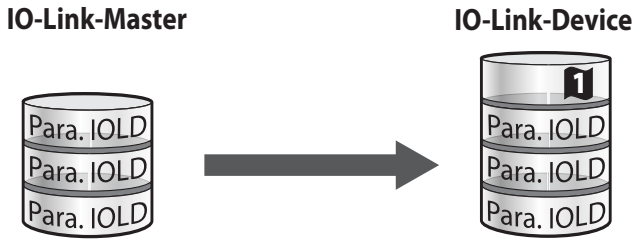


Para. IOLD = parameter data of the IO-Link device

4.4.4 Parameter "data storage mode" = overwrite

- The data set in the master is **always** the reference data set.
- The synchronization of the parameter sets is unidirectional towards to the device.
- The status of the DS_UPLOAD_FLAG is ignored.

Figure 4-4: "Data storage mode" = overwrite

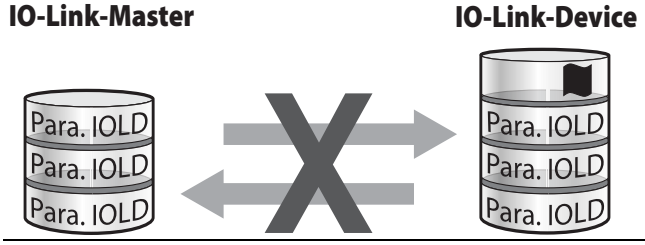


Para. IOLD = parameter data of the IO-Link device

4.4.5 Parameter "data storage mode" = deactivated, clear

- The data set in the master is deleted.
- The synchronization of parameter sets is deactivated.

Figure 4-5: "Data storage mode" = deactivated, clear



4.5 Functions for the acyclic communication via IO-Link CALL

The acyclic access to the data of IO-Link devices is realized via IO-Link CALLs.

Therefore it is necessary to distinguish between data of an IO-Link master or of an IO-Link device.

The addressing of the IO-Link CALL is realized via the so called Entity_Port- It defines which device is addressed via the CALL:

Entity_Port 0 = IO-Link master module (IOLM - BL20/BL67-4IOL)

Entitiy_Port 1 = IO-Link device at 1st channel

Entitiy_Port 2 = IO-Link device at 2nd channel

Entitiy_Port 3 = IO-Link device at 3rd channel

Entitiy_Port 4 = IO-Link device at 4th channel

4.5.1 Port functions for port 0 (IO-Link master)

Subindex 64: Master Port Validation Configuration

Table 4-7: Master Port Validation Configuration

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	64	w	max. 72 byte	This object serves for writing a defined configuration of the IO-Link ports into the master.

Subindex 65: IO-Link Events

Table 4-8: IO-Link Events

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	65	r	255 byte	This object serves for reading the IO-Link events.

NOTE

On "appears" (coming diagnostics) and "Single Shot Events" are shown, as long as they are pending.

Structure of the read data:

- Byte 0 contains 2 bit per IO-Link port which show, if the process data of the connected device are valid or not.
- Byte 0 is followed by 4 byte per Diagnostic Event which clearly assign and specify the diagnostic message.
  A maximum of 14 Events per IO-Link port are shown.

Byte	Bit								
	7	6	5	4	3	2	1	0	
0								x	PD_Valid input port 1
							x		PD_Valid output port 1
						x			PD_Valid input port 2
					x				PD_Valid output port 2
				x					PD_Valid input port 3
			x						PD_Valid output port 3
		x							PD_Valid input port 4
	x								PD_Valid output port 4
1	Qualifier								Defines the type of the Event (Warning, Notification, Single Shot Event, etc.) in accordance with IO-Link specification "IO-Link Interface and System".
2	Port								Indication of the IO-Link port which sends an Event.
3	Event Code high byte								High or respectively low byte of the Event Code sent.
4	Event Code low byte								
...									
222	Qualifier								see byte 1 - 4
223	Port								
224	Event Code high byte								
225	Event Code low byte								

Subindex 66: Set Default Parameterization

Table 4-9: Set Default Parameterization

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	66	w	4 byte	Writing this object sets the IO-Link master back to factory settings. Any parameter setting and configuration is overwritten. The data storage buffer is deleted as well.

Structure of the reset command:

Byte 3	Byte 2	Byte 1	Byte 0
0xEF	0xBE	0xAD	0xDE

Subindex 67: Teach Mode

Table 4-10: Teach Mode

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	67	w	1 byte	The master reads all data (device-Id, vendor-ID, serial number, etc.) from the connected device and saves them. All all previously saved device data are overwritten.

Structure of the Teach command:

Byte 0	
0x00	Teaching all 4 ports
0x01	Teaching port 1
0x02	Teaching port 2
0x03	Teaching port 3
0x04	Teaching port 4
0x05 - 0xFF	reserved

Subindex 68: Master Port Scan Configuration

Table 4-11: Master Port Scan Configuration

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	68	r	max. 120 byte	This object serves for reading the configuration of the IO-Link devices connected to the IO-Link master.

28 byte are returned per IO-Link port

Table 5: Structure of the response telegram

IO-Link Port	Content	Length	Format	Description
Port 1	Vendor_ID	2 byte	UINT16	Vendor-ID of the connected device
	Device_ID	4 byte	UINT32	Device-ID of the connected device
	Function_ID	2 byte	UINT16	reserved
	Serial_Number	16 byte	String	Serial number of the connected device
	COM_Revision	1 byte	UINT8	IO-Link version
	Proc_In_Length	1 byte	UINT8	Process input data length of the connected device
	Proc_Out_Length	1 byte	UINT8	Process output data length of the connected device
	Cycle time		UINT8	Cycle time of the connected device
Port 2	Structure similar to port 1			
Port 3				
Port 4				

Subindex 69: Extended Port Diagnostics

Table 4-1: Extended Port Diagnostics

Entity_ Port	IO-Link subindex	Read Write	Length	Description
0	69	r	max. 8 byte	This object serves for reading the Extended Port Diagnostics.

Structure of the Extended Port Diagnostics:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	NO_SIO	TCYC	-	-	DS_F	NO_DS	-	-
Byte 1	-	WD	MD	PDI_H	-	PDI_E	NO_PD	-
Byte 3								
Byte 4	Device status according to IO-Link specification (see Device Status)							

Table 4-2: Meaning of the Extended Port Diagnostics:

Diagnostic bit	Meaning
NO_DS	The parameterized port mode (see Parameters (page 4-5)) does not support data storage. Remedy: – Change the parameterization of the port.
DS_F	Error in the data storage, synchronization not possible Possible causes: – Connected device does not support data storage – Overflow of the data storage buffer Remedy: – Connect a device that supports data storage. – Clear the data storage buffer. – Deactivate the data storage.
TCYC	The device does not support the cycle time parameterized in the master. Remedy: – Increase the cycle time set in the master
NO_SIO	The device does not support the standard DI mode (see parameter Mode (page 4-5)). Remedy: – Select the IO-Link mode for this port.
NO_PD	No process data available The connected device is not ready for operation. Remedy: – Check the configuration
PDI_E	The connected device reports invalid process data in accordance with IO-Link specification V1.0.
PDI_H	The connected device reports invalid process data in accordance with IO-Link specification V1.1.

Table 4-2: Meaning of the Extended Port Diagnostics:

Diagnostic bit	Meaning
MD	Missing device: No IO-Link device detected Remedy: – Check the IO-Link cable. – Change the device.
WD	Wrong device detected: one or more parameters of the connected device (device-ID, vendor-ID, serial number) does not/ do not match the data which are stored in the master for this device. Remedy: – Change the device. – Adapt the master parameterization (see parameter Mode (page 4-5))

Device Status

Table 4-3: Device Status

Value	Meaning
0	Device works correctly
1	Maintenance Event
2	Out-of-Specification Event
3	Functional check
4	Error
5-255	reserved

5 The IO-Link function block "IOL_CALL"

5.1 General 5-2

5.2 IOL_CALL in accordance with IO-Link specification 5-2

5.2.1 Input variables 5-3
5.2.2 Output variables 5-4
5.2.3 STATUS - communication error status 5-5
5.2.4 IOL_STATUS 5-7

5.1 General

The IO-Link function block IOL_CALL is specified in the IO-Link specification "IO-Link Integration Part 1-Technical Specification for PROFIBUS and PROFINET".

NOTE

Depending on the PLC manufacturer, the IO-Link CALL function block can differ from the specification (for example in the representation or the use of variables).

5.2 IOL_CALL in accordance with IO-Link specification

The following figure shows the function block as it is defined in the specification:

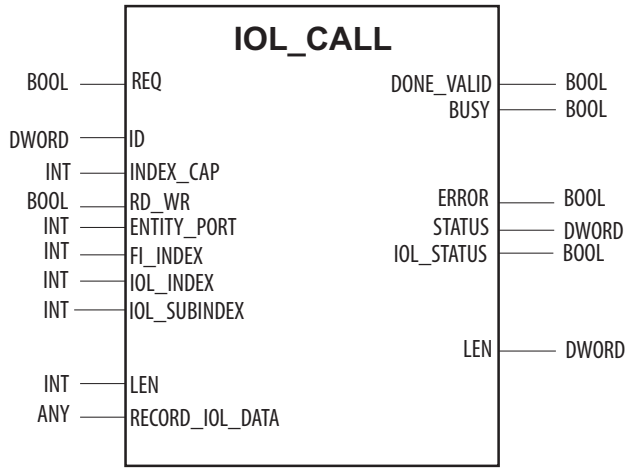


Figure 5-1: IOL_CALL in accordance with IO-Link specification

5.2.1 Input variables

The following description of the function block variables is partially taken from this IO-Link specification.

Table 5-1: Input variables

Name		
IO-Link Spec.	**Data Type**	**Meaning**
REQ	BOOL	A rising edge triggers the send command.
ID	DWORD	Address of the IO-Link master module – PROFIBUS/PROFINET (Siemens): Start address of the input data of the IO-Link master module. – CODESYS: Slot number of the IO-Link master module in the BL20/ BL67 station
INDEX_CAP	INT	Function block instance: 251 to 254
RD_WR	BOOL	0 = read access 1 = write access
ENTITY_PORT	INT	Address of the IO-Link port to be accessed.
FI_INDEX	INT	Fix value (65098): defines the access as IO-Link CALL
IOL_INDEX	INT	Number of the IO-Link index which has to be written or read.
IOL_SUBINDEX	INT	Definition of a possible sub index.
LEN	INT	Length of the data to be read/written. This information is not necessary for the Siemens IOL_-CALL ("IOL_CALL" (FB102) in Step 7 (PROFIBUS-DP/ PROFINET) (page 6-1)). For the IOL_CALL in CODESYS "IOL_CALL" in CODESYS 2.3 (for programmable gateways) (page 7-1) the length of the data to be read or written is necessary.
RECORD_IOL_DATA		Source/destination for the data to be read or written.

5.2.2 Output variables

The following description of the function block variables is partially taken from this IO-Link specification.

Table 5-2: Output variables

Name		
IO-Link Spec.	**Data Type**	**Meaning**
DONE_VALID	BOOL	The read or write access has been executed.
BUSY	BOOL	The read or write access is actually in progress.
ERROR	BOOL	Error while executing the read or write access.
STATUS	DWORD	Communication error status Status of the acyclic communication. → see STATUS - communication error status (page 5-5)
IOL_STATUS	DWORD	IO-Link error messages (in accordance with "IO-Link Integration Part 1- Technical Specification for PROFIBUS and PROFINET" and "IO-Link Interface and System"), which concern the communication between IO-Link master and connected devices. → see IOL_STATUS (page 5-7)
LEN	INT	Length of the data which were read.

5.2.3 STATUS - communication error status

The status of the acyclic communication contains 4 byte and is structured as follows:

Byte 3	Byte 2	Byte 1	Byte 0
Vendor specific identifier (not always applicable)	0×80 Specifies the error as an error of acyclic communication.	Error code → see Table 5-3: Status Codes	Vendor specific identifier (not always applicable)

Table 5-3: Status Codes

Status Code	Name	Meaning
0×FF000000	TIMEOUT	Internal error in the communication with the module
0×00FFFF00	INVALID_HANDLE	
0×00FFFE00	HANDLE_OUT_OF_BUFFERS	
0×00FFFD00	HANDLE_DESTINATION_UNAVAILABLE	
0×00FFFC00	HANDLE_UNKNOWN	
0×00FFFB00	HANDLE_METHOD_INVALID	
0×xx80A0xx	MASTER_READ_ERROR	Error while reading
0×xx80A1xx	MASTER_WRITE_ERROR	Error while writing
0×xx80A2xx	MASTER_MODULE_FAILURE	Failure of the BL20/BL67 gateway, or respectively bus failure
0×xx80A6xx	MASTER_NO_DATA	No data received.
0×xx80A7xx	MASTER_BUSY	BL20/BL67 gateway busy.
0×xx80A9xx	MASTER_FEATURE_NOT_SUPPORTED	BL20/BL67 gateway does not support the function.
0×xx80AAxx	MASTER_RESOURCE_UNAVAILABLE	BL20/BL67 gateway not available.
0×xx80B0xx	ACCESS_INVALID_INDEX	Index invalid, wrong INDEX_CAP used
0×xx80B1xx	ACCESS_WRITE_LENGTH_ERROR	Length of data to be written can not be handled from the module, possible wrong module accessed.
0×xx80B2xx	ACCESS_INVALID_DESTINATION	Wrong slot accessed.
0×xx80B03xx	ACCESS_TYPE_CONFLICT	IOL_CALL invalid.
0×xx80B5xx	ACCESS_STATE_CONFLICT	Error in IOL_CALL sequence
0×xx80B6xx	ACCESS_DENIED	IOL-Link master module refuses the access.

Table 5-3: Status Codes

Status Code	Name	Meaning
0×xx80C2xx	RESOURCE_BUSY	The IO-Link master module is busy or is waiting for an answer of the connected IO-Link device.
0×xx80C3xx	RESOURCE_ UNAVAILABLE	
0×xx8901xx	INPUT_LEN_TOO_SHORT	The index to be read contains more data than defined in the input variable "LEN".

5.2.4 IOL_STATUS

The IOL_STATUS consists of 2 byte Error Code (IOL_M Error_Codes, according to "IO-Link Integration Part 1- Technical Specification for PROFIBUS and PROFINET") and 2 byte Error Type (according to "IO-Link Interface and System").

Byte 3	Byte 2	Byte 1	Byte 0
IOL_M Error_Codes → see Table 5-4: IOL-M Error Codes according to "IO-Link Integration Part 1- Technical Specification for PROFIBUS and PROFINET"		Error Types → see Table 5-5: IOL Error Types according to "IO-Link Interface and System"	

Table 5-4: IOL-M Error Codes

Error Code	Name acc. to spec	Meaning
0×0000	No error	no error
0×7000	IOL_CALL conflict	Unexpected write-request, read request expected
0×7001	Wrong IOL_CALL	Decoding error
0×7002	Port blocked	The accessed port is occupied by another task.
...	reserved	-
0×8000	Timeout	Timeout, IOL master or IOL device port busy.
0×8001	Wrong index	Error: IOL index < 32767 or > 65535 selected.
0×8002	Wrong port address	Port address not available.
0×8003	Wrong port function	Port fucntion not available.
...	reserved	-

Table 5-5: IOL Error Types

Error Code	Name acc. to spec	Meaning
0×1000	COM_ERR	Communication error Possible sources: Possible cause: the addressed port is parameterized as DI and is not in IO-Link mode.
0×1100	I_SERVICE_TIMEOUT	Timeout in communication, Device does not respond in time.
0×5600	M_ISDU_CHECKSUM	Master reports checksum error, access to device not possible.
0×5700	M_ISDU_ILLEGAL	Device can not respond to master request.
0×8000	APP_DEV	Application error in the device
0×8011	IDX_NOTAVAIL	Index not available
0×8012	SUBIDX_NOTAVAIL	Sub index not available
0×8020	SERV_NOTAVAIL	Service temporarily not available
0×8021	SERV_NOTAVAIL_LOCCTRL	Service temporarily not available, device is busy (e. g. teaching or parameterization of the device at the device active).
0×8022	SERV_NOTAVAIL_DEVCTRL	Service temporarily not available, device is busy (e. g. teaching or parameterization of the device via DTM/ PLC etc. active).
0×8023	IDX_NOT_WRITEABLE	Access denied, index not writable
0×8030	PAR_VALOUTOFRNG	Parameter value out of range
0×8031	PAR_VALGTLIM	Parameter value above the upper limit
0×8032	PAR_VALLTLIM	Parameter value below the lower limit
0×8033	VAL_LENOVRRUN	Length of data to be written does not match the length defined for this parameter.
0×8034	VAL_LENUNDRUN	
0×8035	FUNC_NOTAVAIL	Function not available in the device
0×8036	FUNC_UNAVAILTEMP	Function temporarily not available in the device
0×8040	PARA_SETNVALID	Invalid parameter: Parameters not consistent with other parameters in the device.
0×8041	PARA_SETINCONSIST	Inconsistent parameters
0×8082	APP_DEVNOTRDY	Application not ready, device is busy
0×8100	UNSPECIFIC	Vendor specific, see device documentation
0×8101 to 0×80FF	VENDOR_SPECIFIC	

6 "IOL_CALL" (FB102) in Step 7 (PROFIBUS-DP/PROFINET)

6.1 Example project 6-2

6.1.1 Used hardware 6-2
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6.2 Configuration in HW Config 6-3

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6.2.2 Configuration of the IO-Link ports 6-4

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– Write access 6-9

6.1 Example project

6.1.1 Used hardware

- Siemens S7, CPU 315-2 PN/DP, 6ES7-2EH13-0AB0 with PROFINET
- TURCK multiprotocol gateway BL20-E-GW-EN (VN03-00)
  - IO-Link Master BL20-E-4IOL with
    IO-Link port 1: TURCK temperature sensor, TS-500-LUUPN8X-H1141
    IO-Link port 2: not used
    IO-Link port 3: not used
    IO-Link port 4: TURCK IO-HUB, TBIL-M1-16DIP

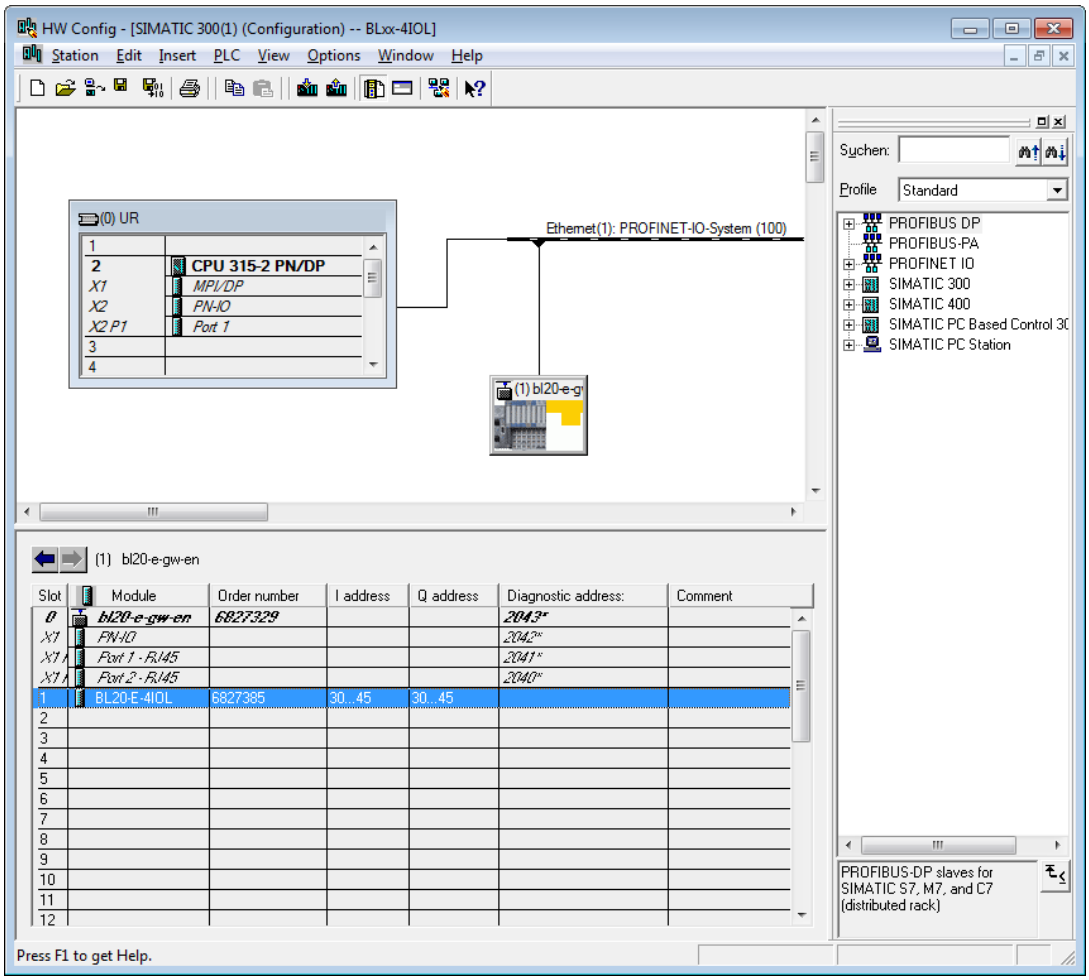
6.1.2 Used software

- SIMATIC Manager, Step 7, version 5.5, SP2

6.2 Configuration in HW Config

6.2.1 Configuration of the IO-Link master

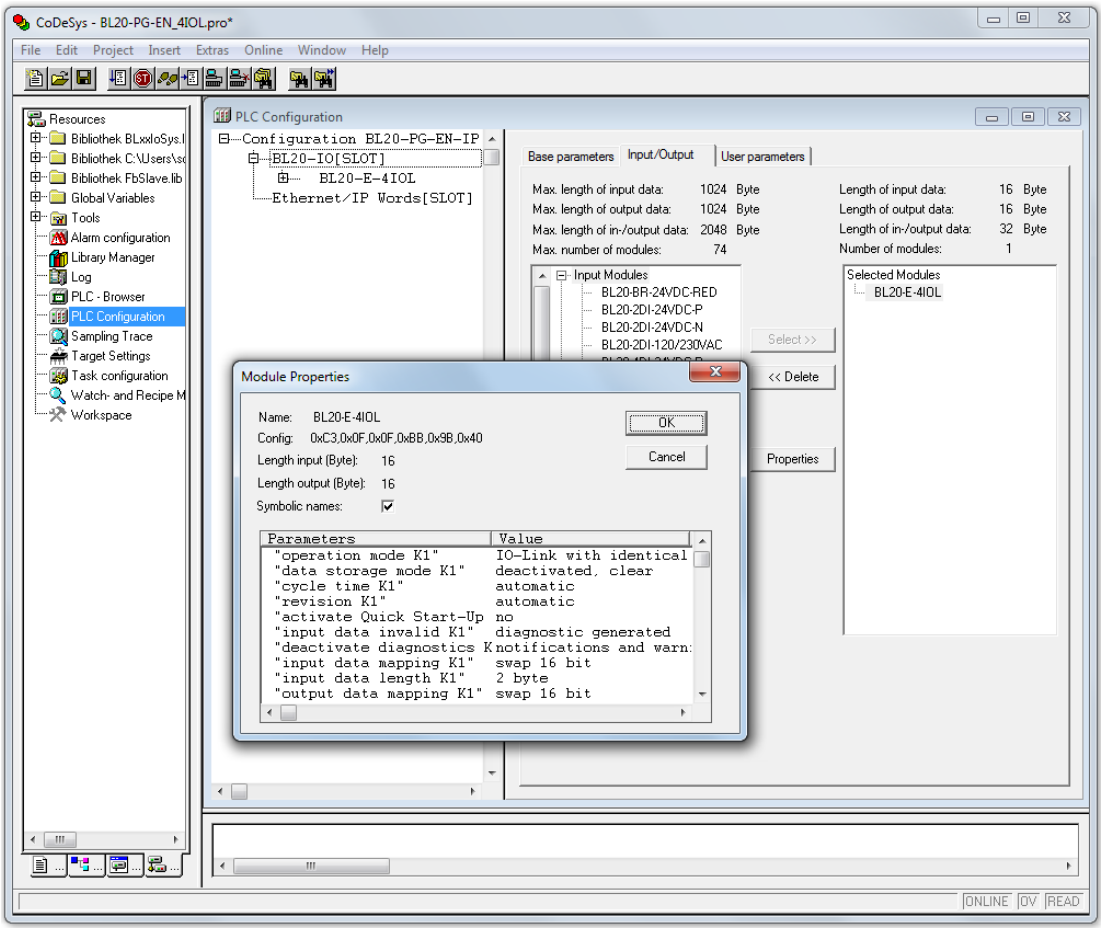
Figure 6-1: Configuration of the IO-Link master



6.2.2 Configuration of the IO-Link ports

The 4 ports of the IO-Link master can be operated in IO-Link mode with different configuration as well as in DI mode (see also parameter Betriebsart (page 4-5)).

Figure 6-2: Configuration of the IO-Link ports



- **Port in IO-Link mode (with identical device, with compatible device, etc.)**
  In "process input data length" and "process output data length" enter the length of process data of the connected device which have to be mapped to the field bus for this port, see also Parameter, page 4-9.
- **Port in DI mode (DI with parameter access, DI)**
  It is reasonable to set the "process input data length" and "process output data length" to 0, in order not to block bytes with digital data in the process data mapping on the fieldbus.

Port configuration in the example project

Port 1:

- **IO-Link with identical device** →Only an identical exchange device is accepted in case of a device exchange (check of vendor-ID, device-ID, etc., see also Parameter, page 4-5).
- Device:
  TURCK temperature sensor,
  TS-500-LUUPN8X-H1141,
  2 byte process data

Port 2 and port 3:

- configured as DI

Port 4:

- **IO-Link without validation** → Every IO-Link device will be accepted as exchange device i case of a device exchange Parameter, page 4-5.
- Device:
  TURCK I/O-hub,
  TBIL-M1-16DIP,
  2 byte process data

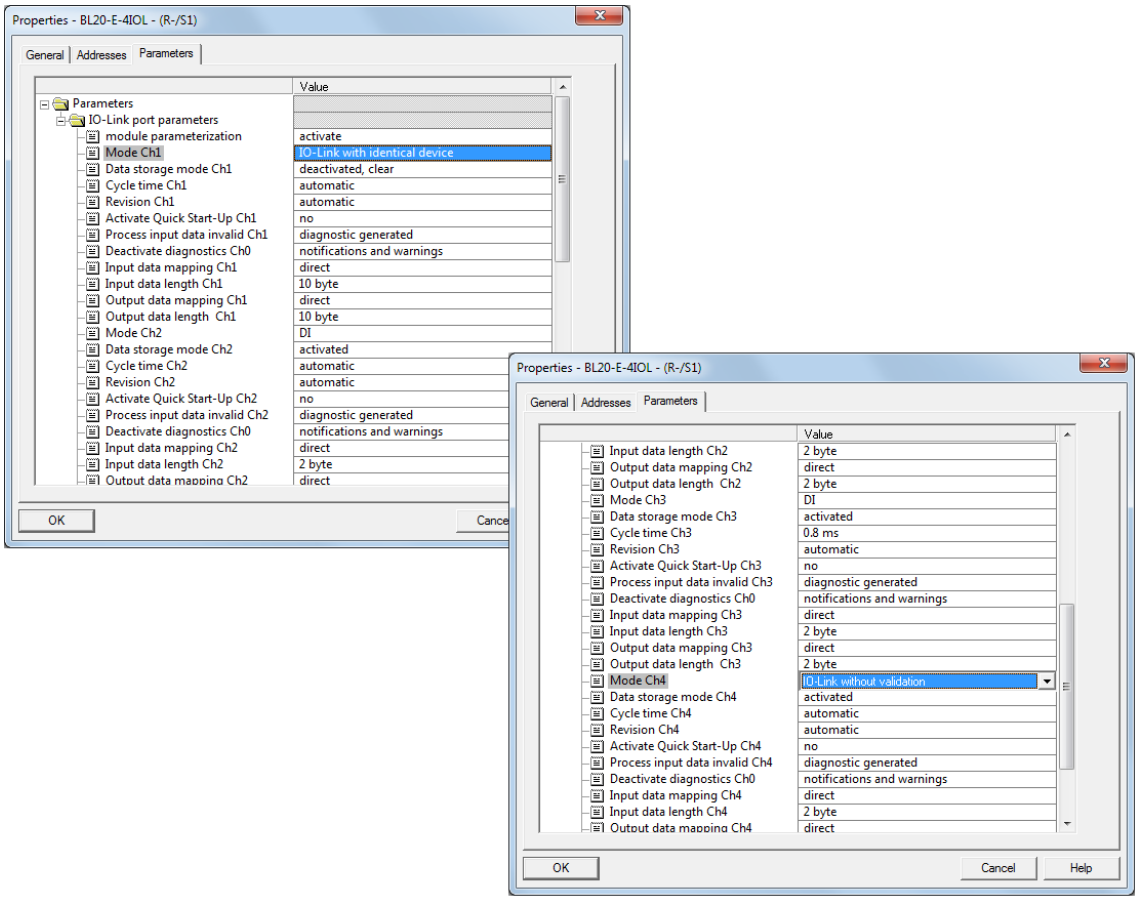
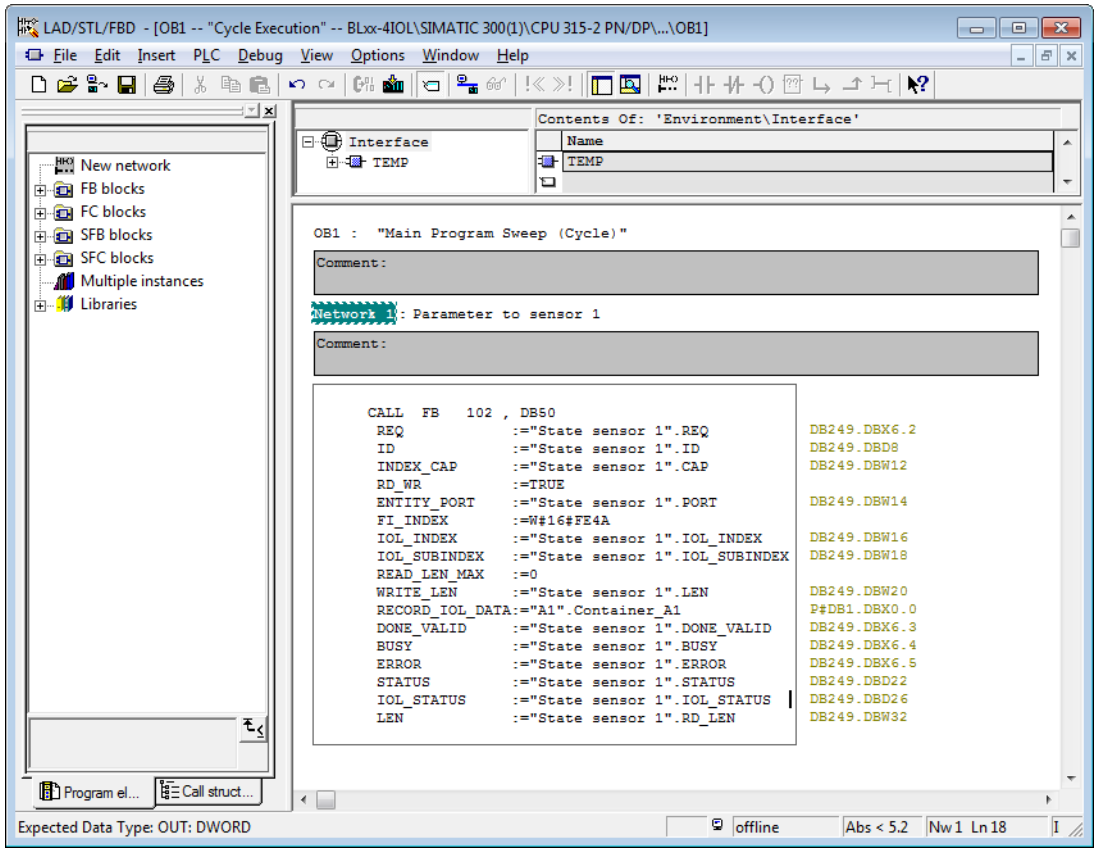


Figure 6-3: Configuration of the IO-Link ports (Example project)

6.3 Usage of the function block in Step 7

The chapter 5 contains a general description of the function block and its in and output variables. The IO-Link function block "IOL_CALL".

Figure 6-4: Example call of Siemens FB IO-Link-CALL (FB102) in OB1



6.3.1 Example accesses with IOL_CALL

In this example, the variable table "HMI" serves to visualize the procedure of the read and write access via IOL_CALL. The devices' process data are shown in the variable tables "Sensor1" or "Sensor2".

The assignment of the SPDU-indices of IO-Link devices can be found in the respective device documentation.

Read access

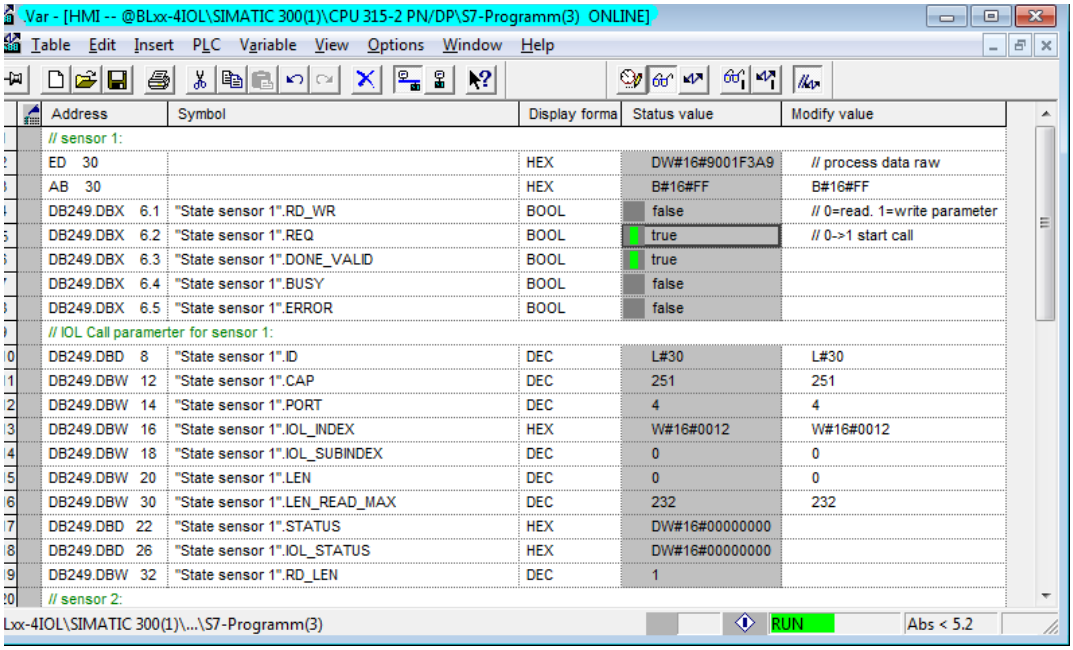
Reading out the product name (product name, index 0x12) of the TURCK IO-Link I/O-hub TBIL-M1-16DIP at IO-Link port 4.

1 Please write the function block's input variables as follows (description see above):

Table 6-1: Example input variables

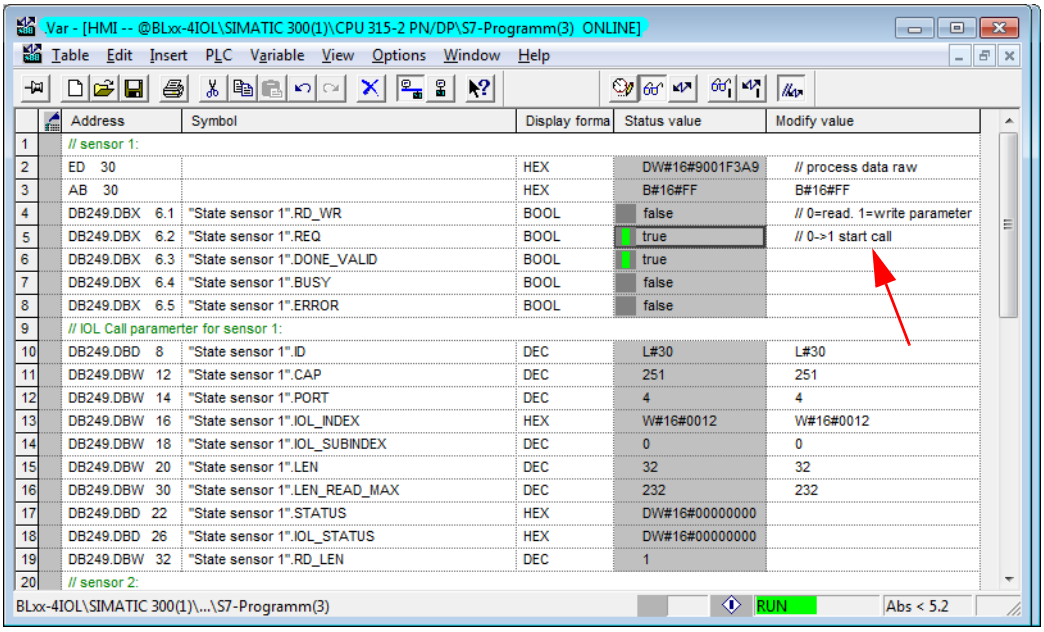
Variable	Value	Meaning
RD_WR	0	Read access
ID	30	Start address of the module's input data according to the configuration in HW Config
CAP (INDEX_CAP)	251	Function block instance
PORT (ENTITY_PORT)	4	The IO-Link device is connected to port 4.
IOL_INDEX	0×12	Index for product name

Figure 6-5: Input variables for read access


Var - [HMI -- @BLxx-4IOL\SIMATIC 300(1)\CPU 315-2 PN/DP\S7-Programm(3) ONLINE]
Table Edit Insert PLC Variable View Options Window Help
Address | Symbol | Display forma | Status value | Modify value
// sensor 1:
ED 30 | HEX | DW#16#9001F3A9 | // process data raw
AB 30 | HEX | B#16#FF | B#16#FF
DB249.DBX 6.1 | "State sensor 1".RD_WR | BOOL | false | // 0=read. 1=write parameter
DB249.DBX 6.2 | "State sensor 1".REQ | BOOL | true | // 0->1 start call
DB249.DBX 6.3 | "State sensor 1".DONE_VALID | BOOL | true
DB249.DBX 6.4 | "State sensor 1".BUSY | BOOL | false
DB249.DBX 6.5 | "State sensor 1".ERROR | BOOL | false
// IOL Call paramerter for sensor 1:
DB249.DBD 8 | "State sensor 1".ID | DEC | L#30 | L#30
DB249.DBW 12 | "State sensor 1".CAP | DEC | 251 | 251
DB249.DBW 14 | "State sensor 1".PORT | DEC | 4 | 4
DB249.DBW 16 | "State sensor 1".IOL_INDEX | HEX | W#16#0012 | W#16#0012
DB249.DBW 18 | "State sensor 1".IOL_SUBINDEX | DEC | 0 | 0
DB249.DBW 20 | "State sensor 1".LEN | DEC | 0 | 0
DB249.DBW 30 | "State sensor 1".LEN_READ_MAX | DEC | 232 | 232
DB249.DBD 22 | "State sensor 1".STATUS | HEX | DW#16#00000000
DB249.DBD 26 | "State sensor 1".IOL_STATUS | HEX | DW#16#00000000
DB249.DBW 32 | "State sensor 1".RD_LEN | DEC | 1
// sensor 2:
Lxx-4IOL\SIMATIC 300(1)\...\S7-Programm(3)
RUN
Abs < 5.2

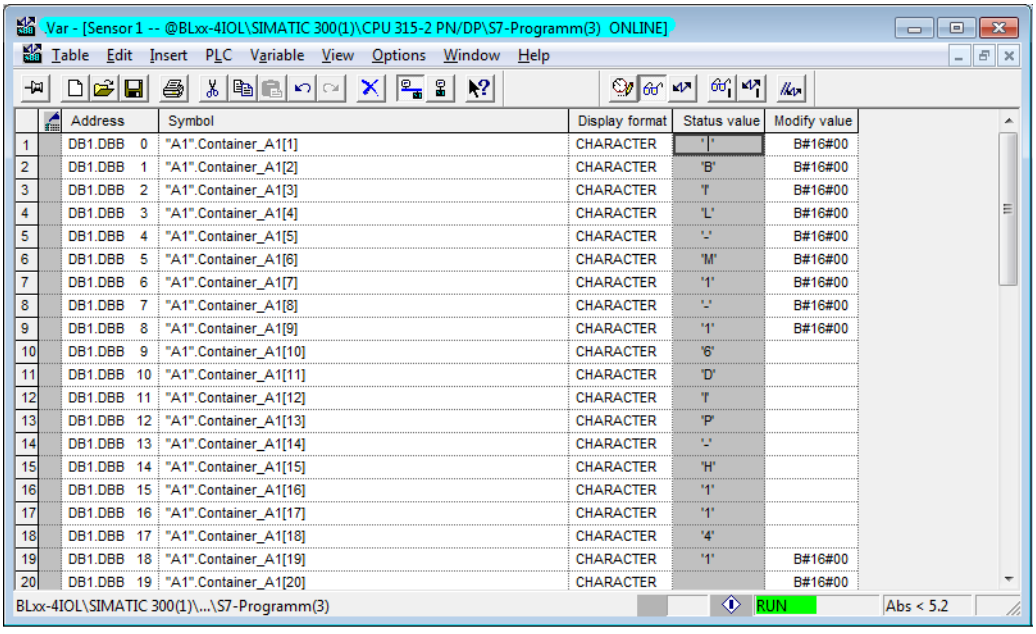
2 After this, the read access has to be activated via a rising edge at "REQ":

Figure 6-6: Activating the read access


Var - [HMI -- @BLxx-4IOL\SIMATIC 300(1)\CPU 315-2 PN/DP\S7-Programm(3) ONLINE]
Table Edit Insert PLC Variable View Options Window Help
Address | Symbol | Display forma | Status value | Modify value
1 // sensor 1:
2 ED 30 | HEX | DW#16#9001F3A9 | // process data raw
3 AB 30 | HEX | B#16#FF | B#16#FF
4 DB249.DBX 6.1 | "State sensor 1".RD_WR | BOOL | false | // 0=read. 1=write parameter
5 DB249.DBX 6.2 | "State sensor 1".REQ | BOOL | true | // 0->1 start call
6 DB249.DBX 6.3 | "State sensor 1".DONE_VALID | BOOL | true
7 DB249.DBX 6.4 | "State sensor 1".BUSY | BOOL | false
8 DB249.DBX 6.5 | "State sensor 1".ERROR | BOOL | false
9 // IOL Call paramerter for sensor 1:
10 DB249.DBD 8 | "State sensor 1".ID | DEC | L#30 | L#30
11 DB249.DBW 12 | "State sensor 1".CAP | DEC | 251 | 251
12 DB249.DBW 14 | "State sensor 1".PORT | DEC | 4 | 4
13 DB249.DBW 16 | "State sensor 1".IOL_INDEX | HEX | W#16#0012 | W#16#0012
14 DB249.DBW 18 | "State sensor 1".IOL_SUBINDEX | DEC | 0 | 0
15 DB249.DBW 20 | "State sensor 1".LEN | DEC | 32 | 32
16 DB249.DBW 30 | "State sensor 1".LEN_READ_MAX | DEC | 232 | 232
17 DB249.DBD 22 | "State sensor 1".STATUS | HEX | DW#16#00000000
18 DB249.DBD 26 | "State sensor 1".IOL_STATUS | HEX | DW#16#00000000
19 DB249.DBW 32 | "State sensor 1".RD_LEN | DEC | 1
20 // sensor 2:
BLxx-4IOL\SIMATIC 300(1)\...\S7-Programm(3)
RUN
Abs < 5.2

3 In this example, the result of this request can be seen in the process data table VAT "Sensor 1".

Figure 6-7: Process data of the sensor


Var - [Sensor1 -- @BLxx-4IOL\SIMATIC 300(1)\CPU 315-2 PN/DP\S7-Programm(3) ONLINE]
Table Edit Insert PLC Variable View Options Window Help
Address | Symbol | Display format | Status value | Modify value
1 DB1.DBB 0 | "A1".Container_A1[1] | CHARACTER | 'I' | B#16#00
2 DB1.DBB 1 | "A1".Container_A1[2] | CHARACTER | 'B' | B#16#00
3 DB1.DBB 2 | "A1".Container_A1[3] | CHARACTER | 'I' | B#16#00
4 DB1.DBB 3 | "A1".Container_A1[4] | CHARACTER | 'L' | B#16#00
5 DB1.DBB 4 | "A1".Container_A1[5] | CHARACTER | '-' | B#16#00
6 DB1.DBB 5 | "A1".Container_A1[6] | CHARACTER | 'M' | B#16#00
7 DB1.DBB 6 | "A1".Container_A1[7] | CHARACTER | '1' | B#16#00
8 DB1.DBB 7 | "A1".Container_A1[8] | CHARACTER | '-' | B#16#00
9 DB1.DBB 8 | "A1".Container_A1[9] | CHARACTER | '1' | B#16#00
10 DB1.DBB 9 | "A1".Container_A1[10] | CHARACTER | '6'
11 DB1.DBB 10 | "A1".Container_A1[11] | CHARACTER | 'D'
12 DB1.DBB 11 | "A1".Container_A1[12] | CHARACTER | 'I'
13 DB1.DBB 12 | "A1".Container_A1[13] | CHARACTER | 'P'
14 DB1.DBB 13 | "A1".Container_A1[14] | CHARACTER | '-'
15 DB1.DBB 14 | "A1".Container_A1[15] | CHARACTER | 'H'
16 DB1.DBB 15 | "A1".Container_A1[16] | CHARACTER | '1'
17 DB1.DBB 16 | "A1".Container_A1[17] | CHARACTER | '1'
18 DB1.DBB 17 | "A1".Container_A1[18] | CHARACTER | '4'
19 DB1.DBB 18 | "A1".Container_A1[19] | CHARACTER | '1' | B#16#00
20 DB1.DBB 19 | "A1".Container_A1[20] | CHARACTER | B#16#00
BLxx-4IOL\SIMATIC 300(1)\...\S7-Programm(3)
RUN
Abs < 5.2

Write access

Changing the parameter "Measured value update time/rotating/disabling a display" (index 55) to the value 0x05 (600 ms measured value update time, display rotated by 180°) for the TURCK temperature sensor TS-500-LUUPN8X-H1141 at IO-Link port 1.

Figure 6-8: Extract from the documentation for TURCK temperature sensors

Temperature sensors TS series
IO-Link Parameters

Specific On-Request Data Objects – Parameter values

Index 0x54; Displayed unit

Value (hexadezcimal)	Menu item	Function
0x00	°C	°C
0x01	°F	°F
0x02	k	k
0x03	Ohm	Ohm

Index 0x55: Measured value update time/rotating/disabling a display

Value (hexadecimal)	Menu item	Function
0x00	50	50 ms measured value update time
0x01	200	200 ms measured value update time
0x02	600	600 ms measured value update time
0x03	r50	50 ms measured value update time, display rotated by 180°
0x04	r200	200 ms measured value update time, display rotated by 180°
0x05	r600	600 ms measured value update time, display rotated by 180°
0x06	OFF	Display disabled

Index 0x56: Behaviour of output 1 in the event of error

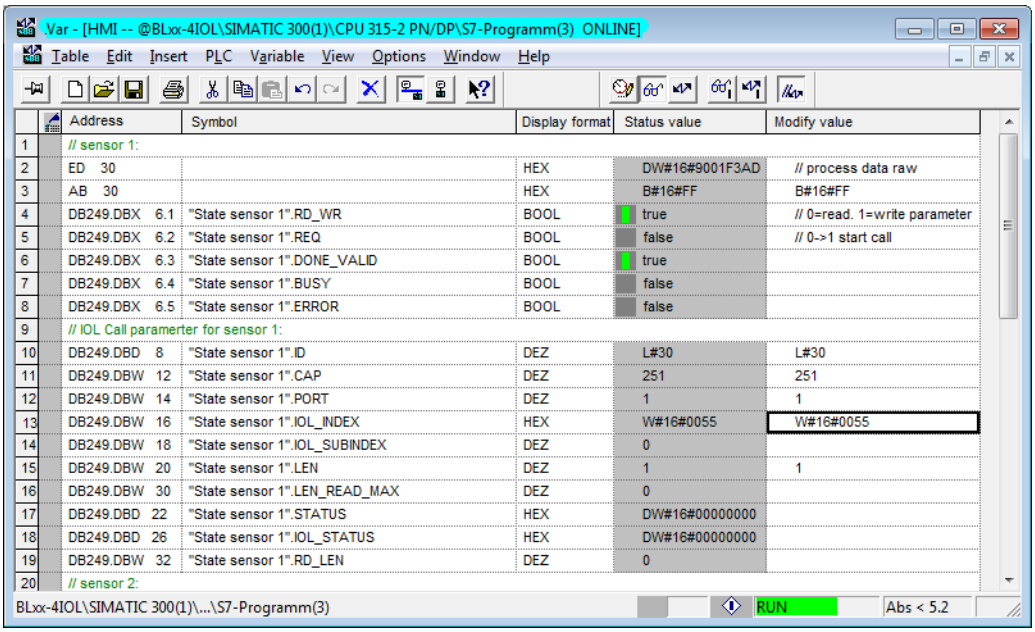
Value (hexadecimal)	Menu item	Function
0x00	Fou1	Output off
0x01	Fou2	Output on

1 Please write the function block's input variables as follows (description see above):

Table 6-2: Example input variables

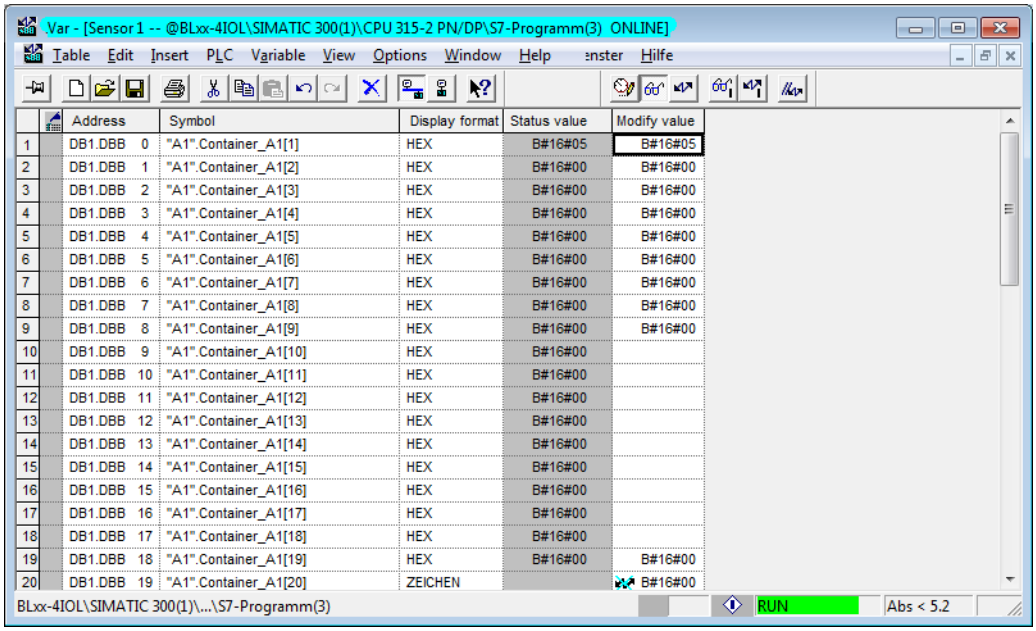
Variable	Value	Meaning
RD_WR	1	Write access
ID	30	Start address of the module's output data according to the configuration in HW Config
CAP (INDEX_CAP)	251	Function block instance
PORT (ENTITY_PORT)	1	The IO-Link device is connected to port 1.
IOL_INDEX	0×55	Index for "Measured value update time/rotating/ disabling a display", see above.
LEN_READ	1	1 byte is written.

Figure 6-9: Input variables for write access


Var - [HMI -- @BLxx-4IOL\SIMATIC 300(1)\CPU 315-2 PN/DP\S7-Programm(3) ONLINE]
Table Edit Insert PLC Variable View Options Window Help
Address | Symbol | Display format | Status value | Modify value
1 // sensor 1:
2 ED 30 HEX DW#16#9001F3AD // process data raw
3 AB 30 HEX B#16#FF B#16#FF
4 DB249.DBX 6.1 "State sensor 1".RD_WR BOOL true // 0=read. 1=write parameter
5 DB249.DBX 6.2 "State sensor 1".REQ BOOL false // 0->1 start call
6 DB249.DBX 6.3 "State sensor 1".DONE_VALID BOOL true
7 DB249.DBX 6.4 "State sensor 1".BUSY BOOL false
8 DB249.DBX 6.5 "State sensor 1".ERROR BOOL false
9 // IOL Call paramerter for sensor 1:
10 DB249.DBD 8 "State sensor 1".ID DEZ L#30 L#30
11 DB249.DBW 12 "State sensor 1".CAP DEZ 251 251
12 DB249.DBW 14 "State sensor 1".PORT DEZ 1 1
13 DB249.DBW 16 "State sensor 1".IOL_INDEX HEX W#16#0055 W#16#0055
14 DB249.DBW 18 "State sensor 1".IOL_SUBINDEX DEZ 0
15 DB249.DBW 20 "State sensor 1".LEN DEZ 1 1
16 DB249.DBW 30 "State sensor 1".LEN_READ_MAX DEZ 0
17 DB249.DBD 22 "State sensor 1".STATUS HEX DW#16#00000000
18 DB249.DBD 26 "State sensor 1".IOL_STATUS HEX DW#16#00000000
19 DB249.DBW 32 "State sensor 1".RD_LEN DEZ 0
20 // sensor 2:
BLxx-4IOL\SIMATIC 300(1)\...\S7-Programm(3)
RUN
Abs < 5.2

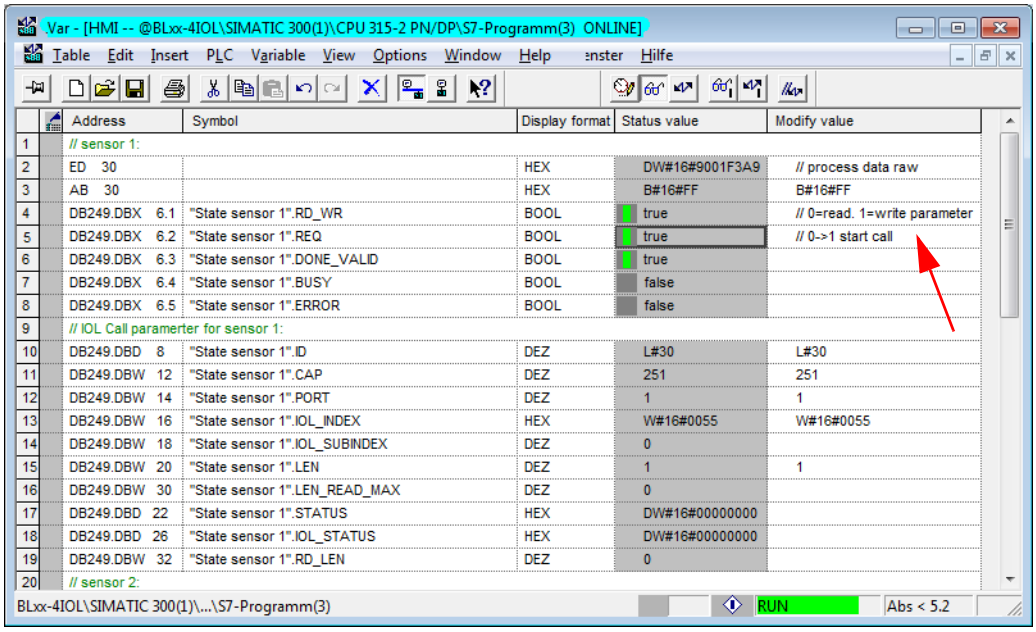
2 The value to be written (0x05) is entered as control value in the variable table (VAT) and is then written.

Figure 6-10: Control value for index 0×55


Var - [Sensor 1 -- @BLxx-4IOL\SIMATIC 300(1)\CPU 315-2 PN/DP\S7-Programm(3) ONLINE]
Table Edit Insert PLC Variable View Options Window Help enster Hilfe
Address Symbol Display format Status value Modify value
1 DB1.DBB 0 "A1".Container_A1[1] HEX B#16#05 B#16#05
2 DB1.DBB 1 "A1".Container_A1[2] HEX B#16#00 B#16#00
3 DB1.DBB 2 "A1".Container_A1[3] HEX B#16#00 B#16#00
4 DB1.DBB 3 "A1".Container_A1[4] HEX B#16#00 B#16#00
5 DB1.DBB 4 "A1".Container_A1[5] HEX B#16#00 B#16#00
6 DB1.DBB 5 "A1".Container_A1[6] HEX B#16#00 B#16#00
7 DB1.DBB 6 "A1".Container_A1[7] HEX B#16#00 B#16#00
8 DB1.DBB 7 "A1".Container_A1[8] HEX B#16#00 B#16#00
9 DB1.DBB 8 "A1".Container_A1[9] HEX B#16#00 B#16#00
10 DB1.DBB 9 "A1".Container_A1[10] HEX B#16#00
11 DB1.DBB 10 "A1".Container_A1[11] HEX B#16#00
12 DB1.DBB 11 "A1".Container_A1[12] HEX B#16#00
13 DB1.DBB 12 "A1".Container_A1[13] HEX B#16#00
14 DB1.DBB 13 "A1".Container_A1[14] HEX B#16#00
15 DB1.DBB 14 "A1".Container_A1[15] HEX B#16#00
16 DB1.DBB 15 "A1".Container_A1[16] HEX B#16#00
17 DB1.DBB 16 "A1".Container_A1[17] HEX B#16#00
18 DB1.DBB 17 "A1".Container_A1[18] HEX B#16#00
19 DB1.DBB 18 "A1".Container_A1[19] HEX B#16#00 B#16#00
20 DB1.DBB 19 "A1".Container_A1[20] ZEICHEN B#16#00
BLxx-4IOL\SIMATIC 300(1)\...\S7-Programm(3)
RUN
Abs < 5.2

3 After this, the write access has to be activated via a rising edge at "REQ":

Figure 6-11: Activating the write access


Var - [HMI -- @BLxx-4IOL\SIMATIC 300(1)\CPU 315-2 PN/DP\S7-Programm(3) ONLINE]
Table Edit Insert PLC Variable View Options Window Help enster Hilfe
Address Symbol Display format Status value Modify value
1 // sensor 1:
2 ED 30 HEX DW#16#9001F3A9 // process data raw
3 AB 30 HEX B#16#FF B#16#FF
4 DB249.DBX 6.1 "State sensor 1".RD_WR BOOL true // 0=read. 1=write parameter
5 DB249.DBX 6.2 "State sensor 1".REQ BOOL true // 0->1 start call
6 DB249.DBX 6.3 "State sensor 1".DONE_VALID BOOL true
7 DB249.DBX 6.4 "State sensor 1".BUSY BOOL false
8 DB249.DBX 6.5 "State sensor 1".ERROR BOOL false
9 // IOL Call parameter for sensor 1:
10 DB249.DBD 8 "State sensor 1".ID DEZ L#30 L#30
11 DB249.DBW 12 "State sensor 1".CAP DEZ 251 251
12 DB249.DBW 14 "State sensor 1".PORT DEZ 1 1
13 DB249.DBW 16 "State sensor 1".IOL_INDEX HEX W#16#0055 W#16#0055
14 DB249.DBW 18 "State sensor 1".IOL_SUBINDEX DEZ 0
15 DB249.DBW 20 "State sensor 1".LEN DEZ 1 1
16 DB249.DBW 30 "State sensor 1".LEN_READ_MAX DEZ 0
17 DB249.DBD 22 "State sensor 1".STATUS HEX DW#16#00000000
18 DB249.DBD 26 "State sensor 1".IOL_STATUS HEX DW#16#00000000
19 DB249.DBW 32 "State sensor 1".RD_LEN DEZ 0
20 // sensor 2:
BLxx-4IOL\SIMATIC 300(1)\...\S7-Programm(3)
RUN
Abs < 5.2

4 The sensor's display is now rotated for about 180°, the update time is set to 600 ms.

7 "IOL_CALL" in CODESYS 2.3 (for programmable gateways)

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7.1 Example project

7.1.1 Used hardware

- TURCK BL20-PG-EN-IP (FW V 2.10.0.3)
  - IO-Link Master BL20-E-4IOL with
    IO-Link port 1: TURCK temperature sensor, TS-500-LUUPN8X-H1141
    IO-Link port 2: not used
    IO-Link port 3: not used
    IO-Link port 4: TURCK IO-HUB, TBIL-M1-16DIP

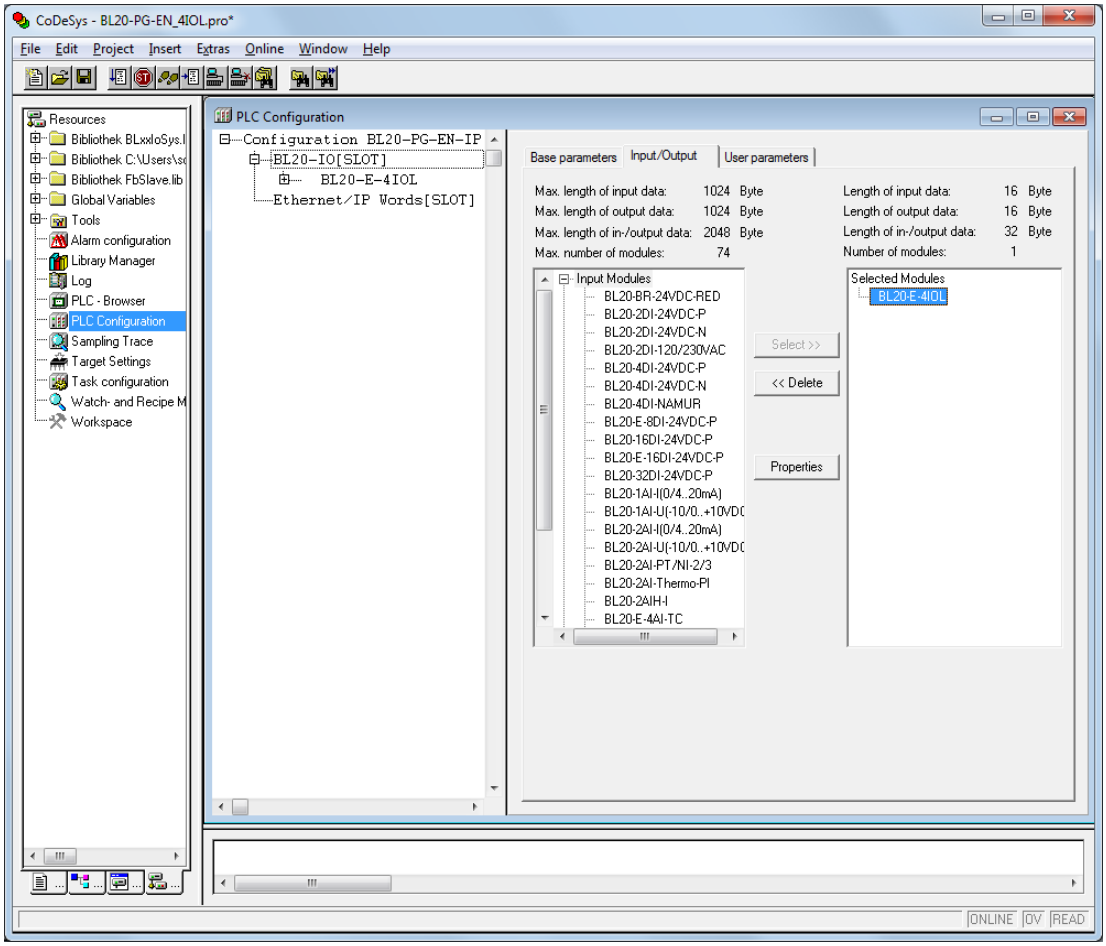
7.1.2 Used software

- CODESYS V2.3.9.35
- Target Support Package, for BL20-PG-EN-IP, version 2.1.3.0

7.2 Configuration in CODESYS 2.3

7.2.1 Configuration of the IO-Link master

Figure 7-1: Configuration of the IO-Link master



7.2.2 Configuration of the IO-Link ports

The 4 ports of the IO-Link master can be operated in IO-Link mode with different configuration as well as in DI mode (see also parameter Mode (page 4-5)).

- **Port in IO-Link mode (with identical device, with compatible device, etc.)**
  In "process input data length" and "process output data length" enter the length of process data of the connected device which have to be mapped to the field bus for this port, see also Parameters, page 4-8.
- **Port in DI mode (DI with parameter access, DI)**
  It is reasonable to set the "process input data length" and "process output data length" to 0, in order not to block bytes with digital data in the process data mapping on the fieldbus.

Port configuration in the example project

Port 1:

- **IO-Link with identical device** →Only an identical exchange device is accepted in case of a device exchange (check of vendor-ID, device-ID, etc., see also Parameters, page 4-5).
- Device:
  TURCK temperature sensor,
  TS-500-LUUPN8X-H1141,
  2 byte process data

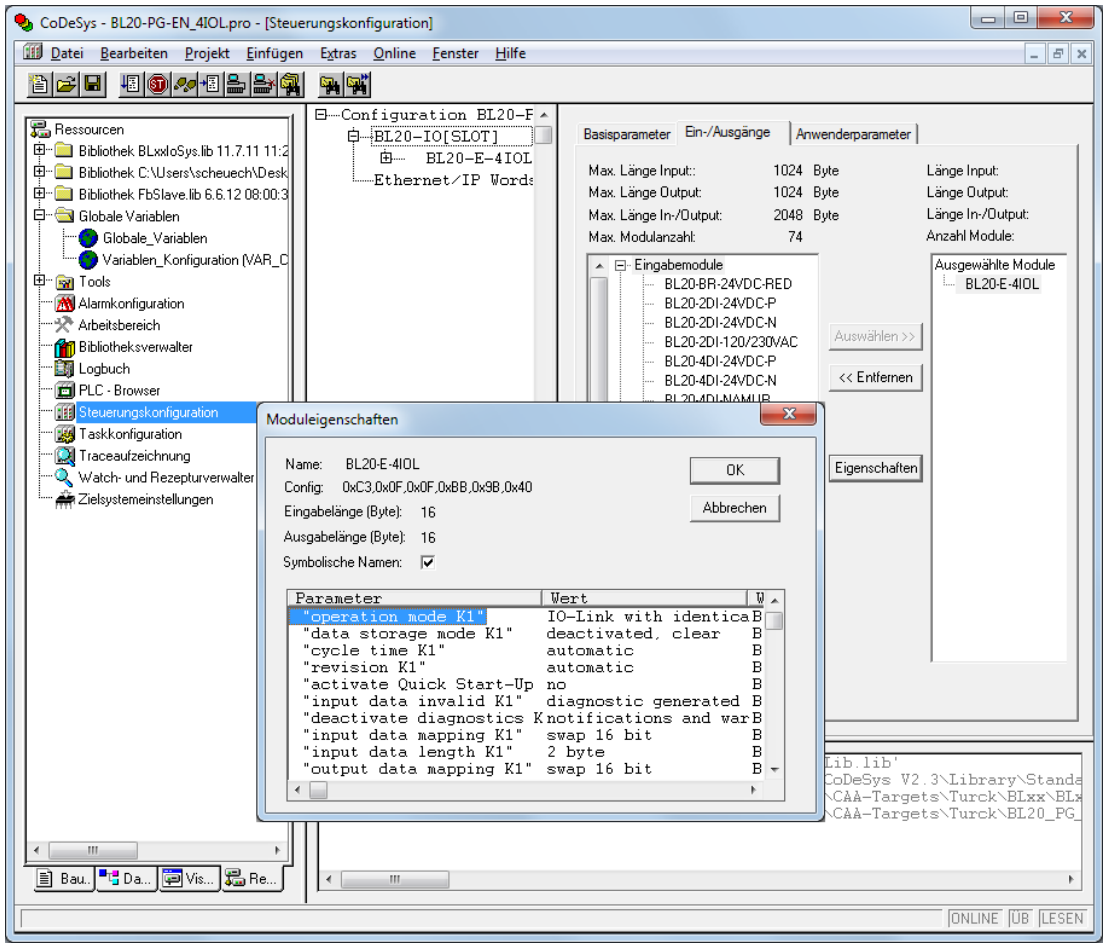
Port 2 and port 3:

- configured as DI

Port 4:

- **IO-Link without validation** → Every IO-Link device will be accepted as exchange device in case of a device exchange Parameters, page 4-5.
- Device:
  TURCK I/O-hub,
  TBIL-M1-16DIP,
  2 byte process data

Figure 7-2: Configuration of the IO-Link ports (Example project)



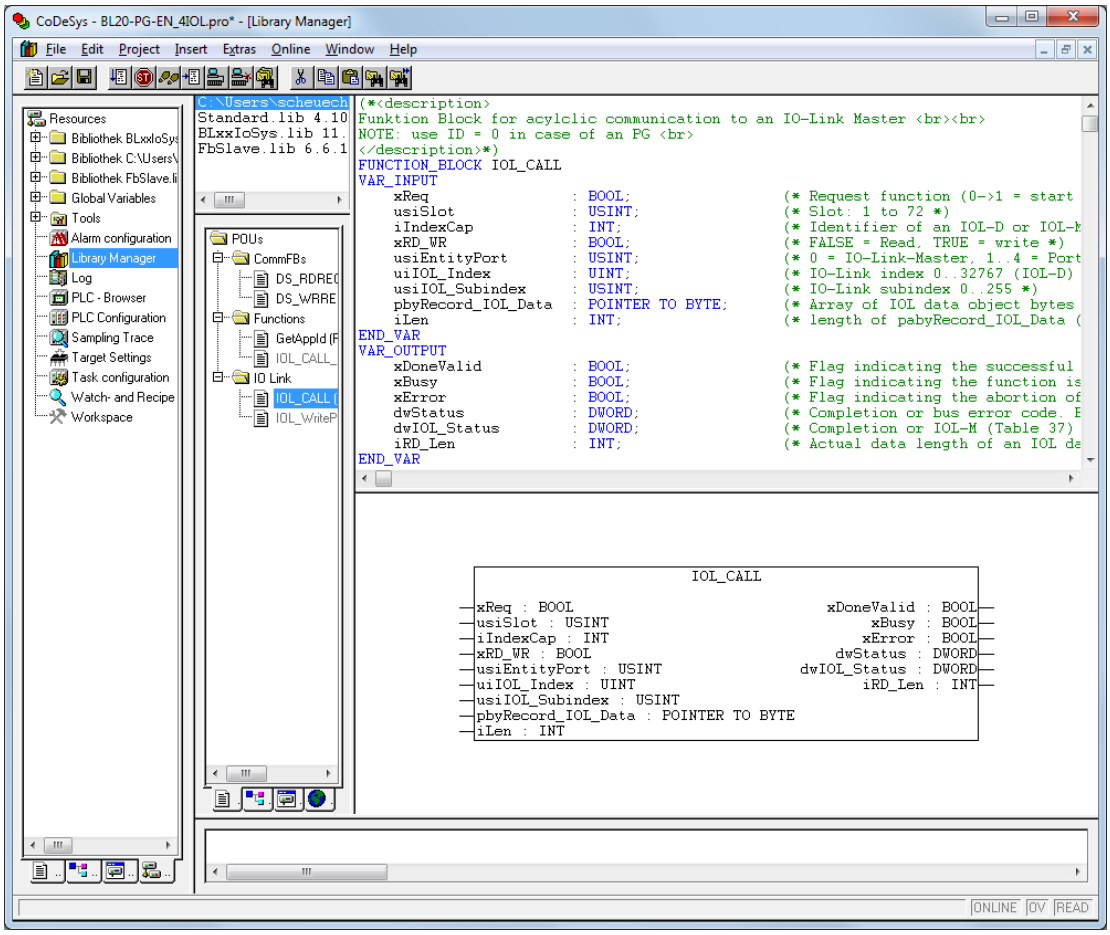
7.3 Usage of the function block in CODESYS 2.3

The chapter 5 contains a general description of the function block and its in and output variables. The IO-Link function block "IOL_CALL".

The IOL-CALL-FB is part of the TURCK library "BLxx_PG_FB.lib".

This TURCK library is contained in the device's Target Support Package. The Target Support Package can be downloaded at the programmable gateway (e.g. at BL20-PG-EN) under www.turck.de.

Figure 7-3: TURCK FB in CODESYS 2.3



7.3.1 Example accesses with IOL_CALL

The assignment of the SPDU-indices of IO-Link devices can be found in the respective device documentation.

Read access

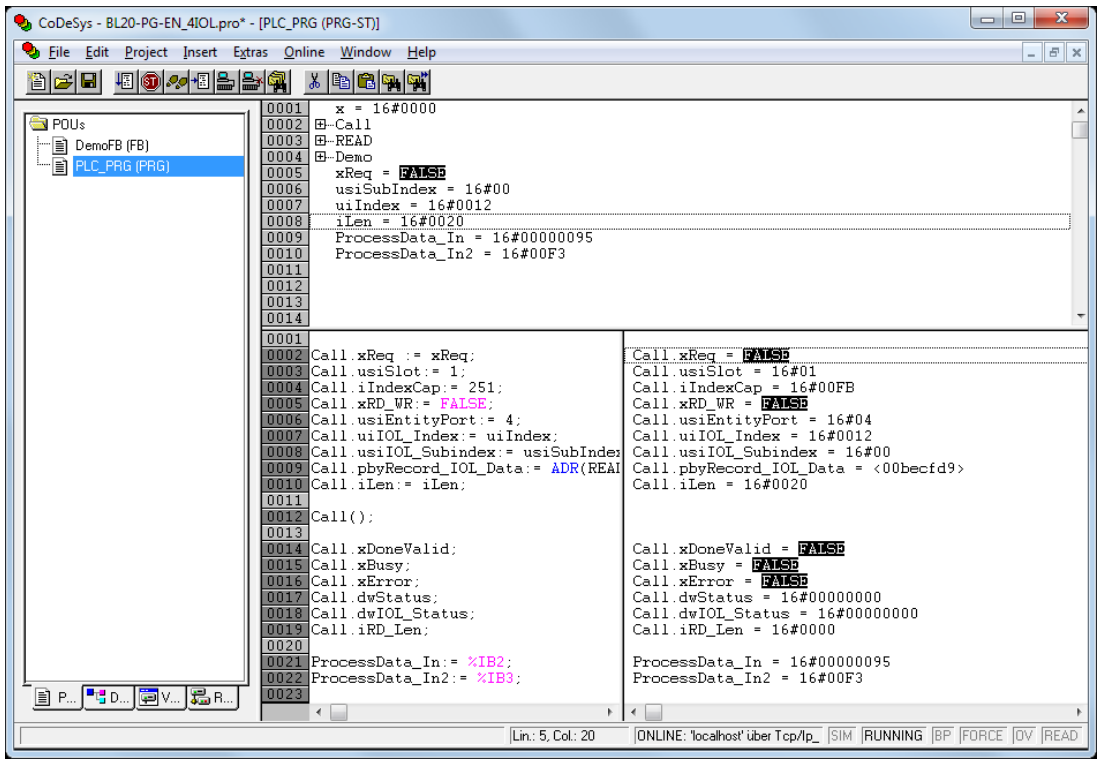
Reading out the product name (product name, index 0x12) of the TURCK IO-Link I/O-hub TBIL-M1-16DIP at IO-Link port 1.

1 Please write the function block's input variables as follows (description see below):

Table 7-1: Example input variables

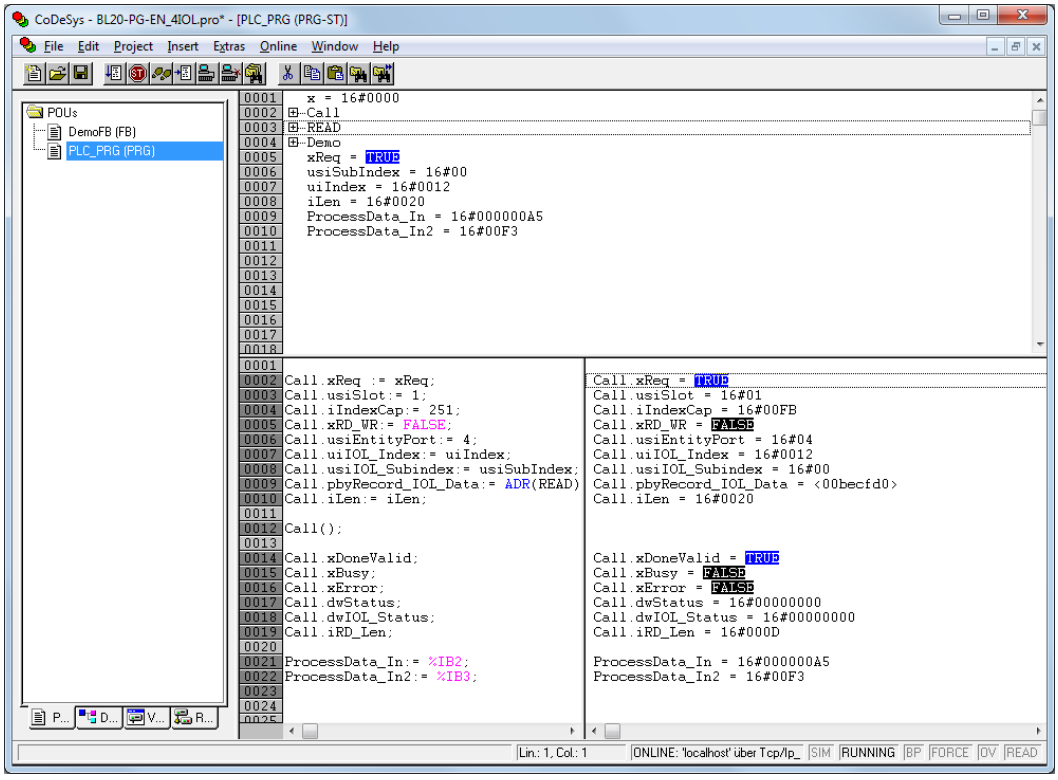
Variable	Value	Meaning
RD_WR	0	Read access
Slot	1	Position of the module in the BL20/BL67 station
IndexCap	251	Function block instance
EntityPort	4	The IO-Link device is connected to port 4.
IOL_Index	0×12	Index for product name
LEN	32 (0×20)	32 byte are read out Length of the data to be read, min. length = real length of the data, max. length = length of the defined data buffer

Figure 7-4: Input variables for the read access



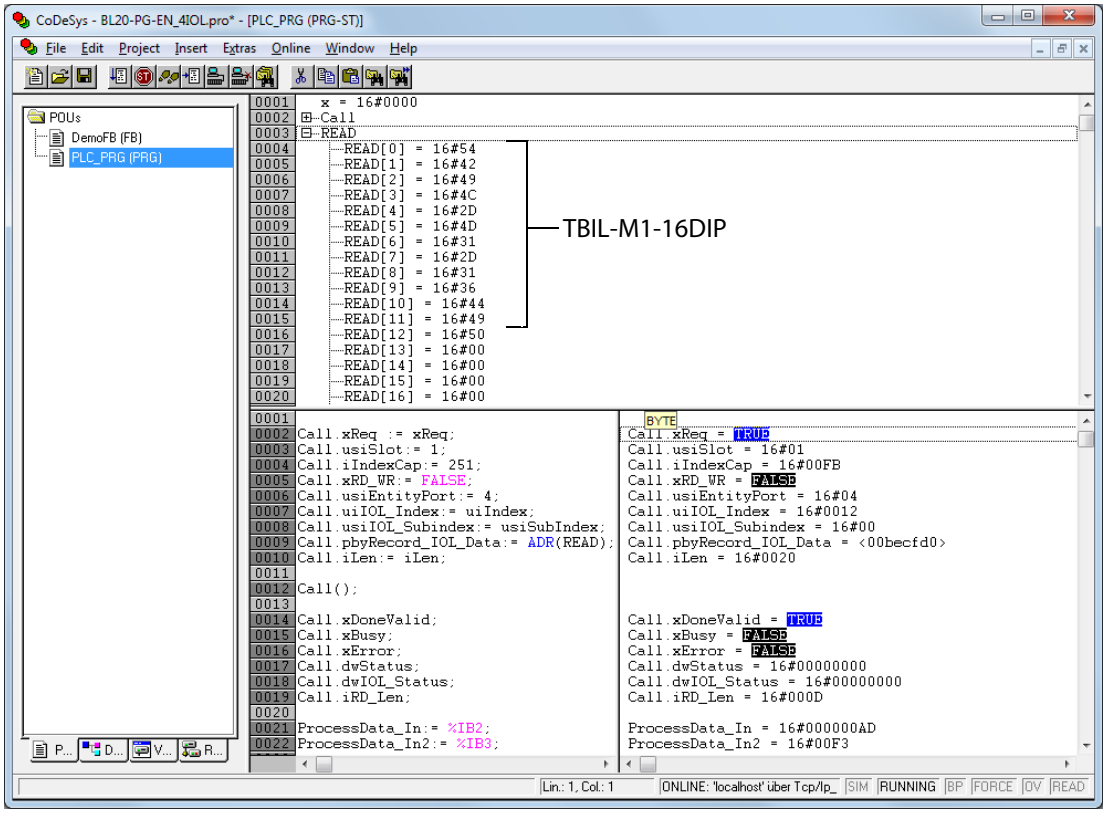
2 After this, the read access has to be activated via a rising edge at "REQ":

Figure 7-5: Activating the read access



3 In this example, the result of this request can be found in the data array "READ":

Figure 7-6: Process data of the sensor



Write access

Changing the parameter "Measured value update time/rotating/disabling a display" (index 55) to the value 0x05 (600 ms measured value update time, display rotated by 180°) for the TURCK temperature sensor TS-500-LUUPN8X-H1141 at IO-Link port 1.

Figure 7-7: Extract from the documentation for TURCK temperature sensors

Temperature sensors TS series
IO-Link Parameters

TURCK Industrial Automatio

Specific On-Request Data Objects – Parameter values

Index 0x54; Displayed unit

Value (hexadezcimal)	Menu item	Function
0x00	°C	°C
0x01	°F	°F
0x02	k	k
0x03	Ohm	Ohm

Index 0x55: Measured value update time/rotating/disabling a display

Value (hexadecimal)	Menu item	Function
0x00	50	50 ms measured value update time
0x01	200	200 ms measured value update time
0x02	600	600 ms measured value update time
0x03	r50	50 ms measured value update time, display rotated by 180°
0x04	r200	200 ms measured value update time, display rotated by 180°
0x05	r600	600 ms measured value update time, display rotated by 180°
0x06	OFF	Display disabled

Index 0x56: Behaviour of output 1 in the event of error

Value (hexadecimal)	Menu item	Function
0x00	Fou1	Output off
0x01	Fou2	Output on

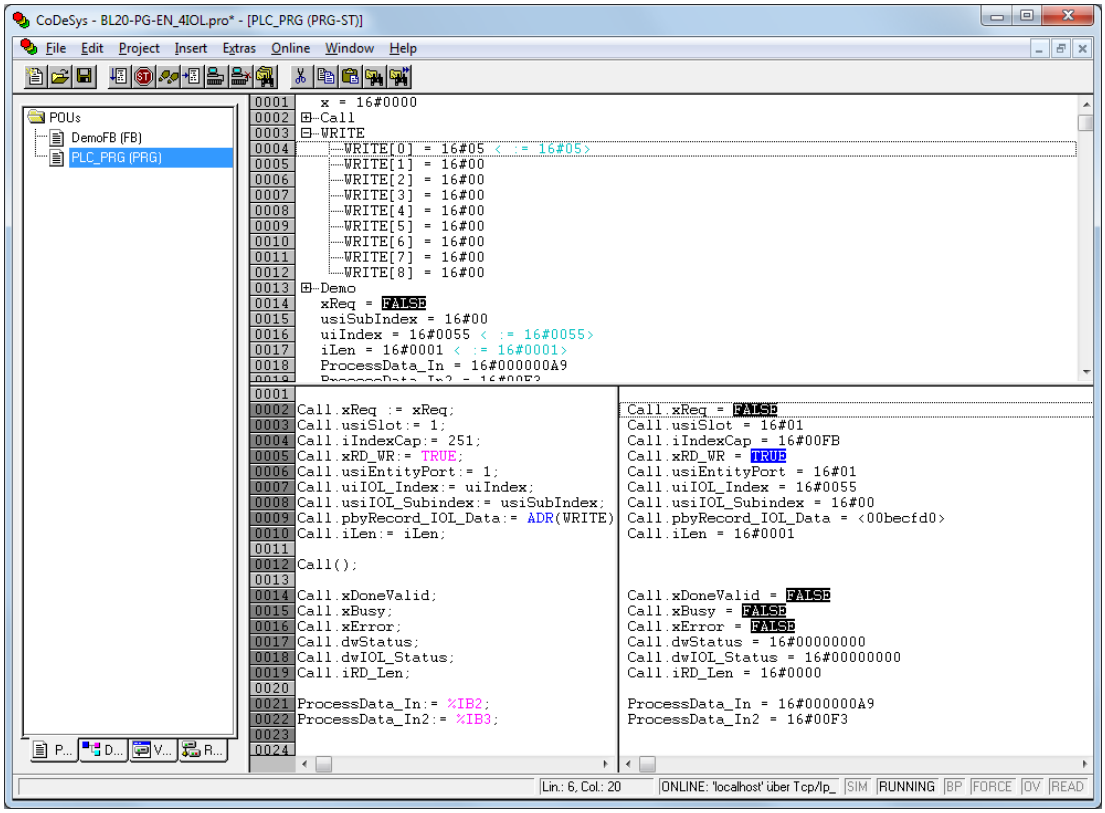
1 Please write the function block's input variables as follows (description see above):

Table 7-2: Example input variables

Variable	Value	Meaning
RD_WR	1	Write access
Slot	1	Position of the module in the BL20/BL67 station
IndexCap	251	Function block instance
EntityPort	1	The IO-Link device is connected to port 1.
IOL_Index	0×55	Index for "Measured value update time/rotating/ disabling a display", see Figure 7-7: Extract from the documentation for TURCK temperature sensors.
LEN	1	1 byte is written.

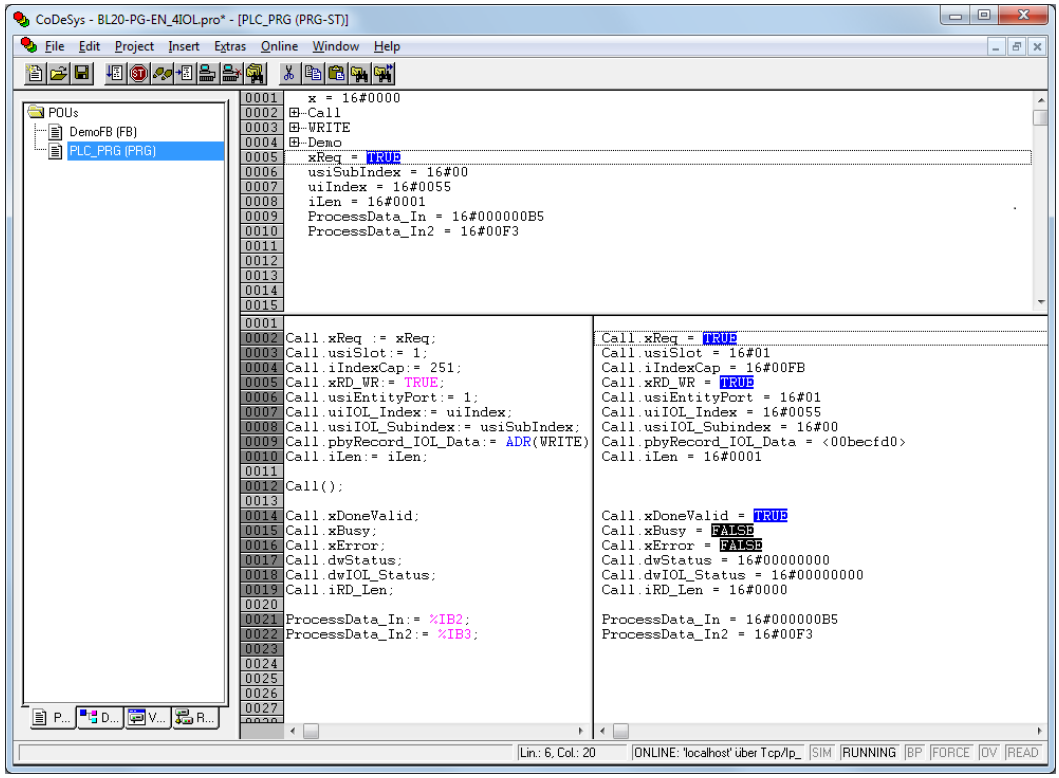
2 The value to be written (0x05) is entered in the data array "WRITE" and is then written.

Figure 7-8: Input variables for write access



3 After this, the write access has to be activated via a rising edge at "REQ":

Figure 7-9: Activating the write access



4 The sensor's display is now rotated for about 180°, the update time is set to 600 ms.

8 Appendix

8.1 Start-up: IO-Link-Device with IO-Link V1.0 2

8.2 Start-up: IO-Link-Device with IO-Link V1.1 3

8.3 Start-up problems - frequent failure causes 4

8.1 Start-up: IO-Link-Device with IO-Link V1.0

In general, the following applies:
IO-Link devices in accordance with IO-Link specification V1.0 **do not support data storage**. This means, that the parameter "Data storage mode" has to be set to "deactivated,clear" if an IO-Link V1.0 devices is used.

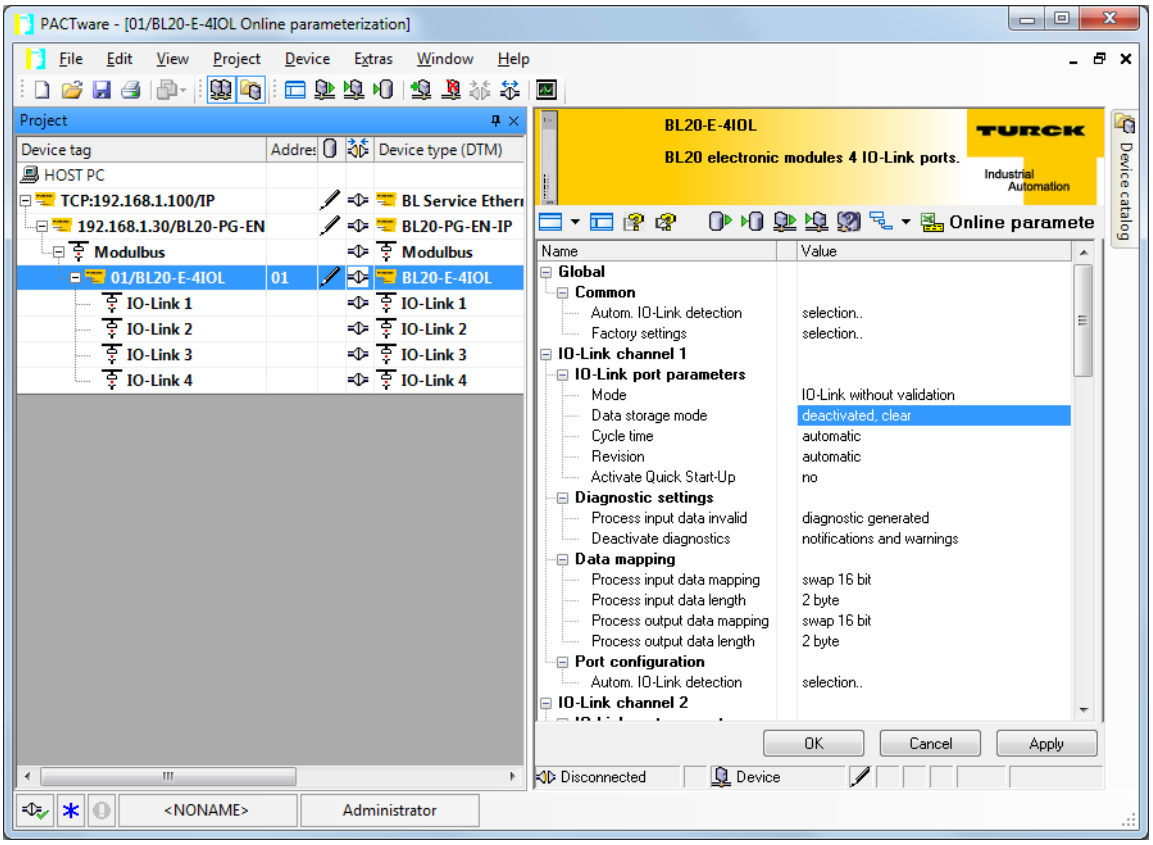


Figure 8-1: Data storage mode deactivated, clear

Start-up steps

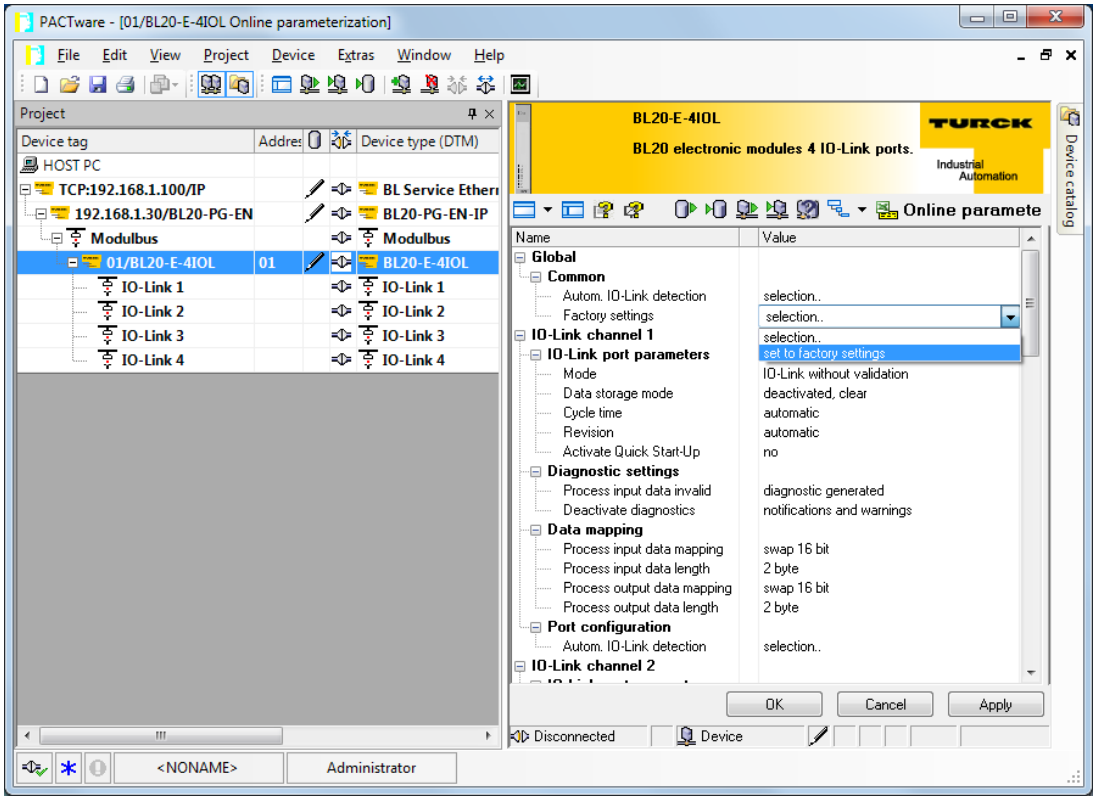
- ➤ Deactivate the data storage mode for the respective IO-Link port,
- ➤ Download the parameters into the device, all other parameters can be set to default settings,
- ➤ Connect the IO-Link V1.0 device.
- ➥ LED "IOL" = GREEN (for the respective port), IO-Link communication is active

8.2 Start-up: IO-Link-Device with IO-Link V1.1

In general, the following applies:

- The data storage of the master should be cleared before a device with a different device type is connected to an IO-Link port which has already been used before.
  To do so, set the master back to factory settings or clear the data storage buffer using the parameter "data storage mode".

Figure 8-2: Reset master to factory settings



Start-up steps (1. possibility)

➤ Set parameter "factory settings" to "set to factory settings",

➥ The DTM resets the device automatically,

➤ Connect the IO-Link V1.1 device.

➥ LED "IOL" = GREEN (for the respective port), IO-Link communication is active

Start-up steps (2. possibility)

➤ Set the "data storage mode" to "deactivated,clear",

➤ Download the parameters into the device,

➤ Re-activate the data storage if required,

➤ Download the parameters into the device,

➤ Connect the IO-Link V1.1 device.

➥ LED "IOL" = GREEN (for the respective port), IO-Link communication is active

8.3 Start-up problems - frequent failure causes

LED	Diagnostics	Possible causes	Explanation/solution
DIA and **IOL** red, flashing	Data storage error	IO-Link device in accordance with IO-Link V1.0 connected. IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage	Deactivate the data storage. To do so, set parameter "Data storage mode" to "deactivated, clear", see page 4-6.
		The data storage buffer contains data of another device.	Clear the data storage buffer of the master. To do so, set the parameter "Data storage mode" to "deactivated, clear", seepage 4-6, and re-activate the data storage if necessary.
	Wrong or missing device	The connected device does not match the configured one (wrong vendor-ID, device-ID etc.).	Change the parameterization of the IO-Link port at the master. Correct the vendor-ID, device-ID, etc. The parameterization can be done by teaching the master via IOL_CALL using the port function Subindex 67: Teach Mode or via a manual port parameterization.
	Process input data invalid	Certain IO-Link devices send a "process input data invalid"-diagnosis if the process value can not be measured.	Deactivate the sending of the "process input data invalid"-diagnosis for the respective port. To do so, set parameter "Process input data invalid" to "no diagnostic generated", see page 4-7.

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